

**A Short Summary of MPSC  
Case U-17053**

**The Forced DTE AMI Mandate  
And  
OPT-OUT**

**We have not done a study to whether customers thought the AMI program was excellent and if they would recommend it to neighbors or other communities as regarding the ratio of people whom are content with AMI meters or people that want to opt out of the AMI program.**

**Robert Sitkauskas, DTE AMI Manager  
MPSC Case U-17053 - Pages 421 and 422**

Note; There is no customer CHOICE whether to accept or to pay, for DTE's forced AMI meter mandate.

**By**

**John A. Holeton**

**March 8, 2017**

**(Intervener – MPSC Case U-17053)**

## **Introduction**

March 6, 2017

I believe the citizens of the State of Michigan have been denied the due process under the Constitution of the United States' XIV Amendment. Not by making or enforcing a particular law but from failing to enforce the laws of the State of Michigan such as Michigan's Consumer Protection Act PA 331 of 1976 and MCL 750.539d.

These laws were to speak specifically of protecting the rights of homeowners from unnecessarily being injured by businesses and corporations and to give the home owner the choice to protect themselves from any type of data collection device and the collection of data without their permission within their home.

I believe injury to Citizens of Michigan is being done by this legislature allowing a third party known as the Michigan Public Service Commission, a non-elected body, acting as a Public Private Partnership with the Electrical Utility monopolies, not for the citizens. The issues of cost, health, invasion of property and safety are not easily resolved by citizens whom may not have the money, education or resources through complaints and law suits for what they believe are potential hazards to their way of life. The rules and guidelines of the MPSC make it almost impossible for the non-lawyer citizen to seek recourse from the MPSC as documented in MPSC Case U-17986.

### **Amendment XIV**

#### **Section 1.**

All persons born or naturalized in the United States, and subject to the jurisdiction thereof, are citizens of the United States and of the state wherein they reside. **No state shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any state deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws.**

The only protection for citizens and customers such as those terminated from life protecting electrical power as the (19) listed on the accompanying sheet is the HB 4220. None of the AMI customers were given a choice not to pay for a meter upgrade to AMI and the infrastructure to accommodate it. A fair law such as HB 4220 that acknowledges the AMI meters and thus the utility corporations such as DTE are being subsidized by ALL customers already will give a lawful choice and protection to all customers.

I provide the above listed documentation and Summary, of MPSC Case U-17053, testimony of Robert Sitkauskas, DTE AMI manager, all inclusive (32) pages to support the need for HB 4220.

Sincerely



John A. Holeton

## Smart Meter Shut-off Victims

date of shut-off

1. Georgetta Livingstone 9984 Maple Valley Dr. Jul 10, 2014 248-563-4378 [glivingstone@juno.com](mailto:glivingstone@juno.com)  
Clarkston 48348
2. Andrea McNinch Royal Oak Dec. 18, '14 248-721-7163 [andrea@andreamcninch.com](mailto:andrea@andreamcninch.com)
3. Myron & JoAnn Nims 9493 Pontiac Trail, South Lyon 48178 June 10, '14 248-446-1053 [mnims1@nims-precision.com](mailto:mnims1@nims-precision.com)
4. Jon Muresan 2707 Linwood, R.O. 48073 248-288-5259 [jon@muresan.com](mailto:jon@muresan.com)
5. Ralph & Donna Stenman Farmington Aug. 14, '15 248-987-6367 [restenman@sbcglobal.net](mailto:restenman@sbcglobal.net)
6. David & Joanie Sheldon Oak Park 248-604-7545 [fdshel@gmx.com](mailto:fdshel@gmx.com)
7. David Lonier & Glenna Auburn Hills Sept. 9, 2015 248-373-9111 [davidlonier@gmail.com](mailto:davidlonier@gmail.com)
8. Jim Cipa Warren Sept 9, 2015 586-764-6054 [rocko123@wowway.com](mailto:rocko123@wowway.com)
9. Joe & Jaimie Chimner 1103 N. Western, Cheboygan Sept. 11, '15 231-818-1312 [joachim@att.net](mailto:joachim@att.net)
10. Molly Cleary Ann Arbor Mar 18, 2015 734-930-6926 [mollyjcleary@gmail.com](mailto:mollyjcleary@gmail.com)
11. Leslie Glapa/Panzica Dexter 734-545-4913 [leslie.panzica@gmail.com](mailto:leslie.panzica@gmail.com)
12. Phillis DeSaele April 9, 2015 [desaele@wideopenwest.com](mailto:desaele@wideopenwest.com)
13. Karen Kane 705 E. Robert, Hazel Park April 6, 2015 248-547-0613
14. Phil Filiccia 21312 Patterson Dr. Macomb 48044 April 8, 2015 586-421-0092 989-832-2493
15. Rebecca Scholz 450 John Raul Dr, Macomb April 8, 2015
16. Dustin Milton 21350 Cachet Dr., Macomb April 8, 2015 [dusty9755@att.net](mailto:dusty9755@att.net)
17. Olga Puste 1385 Moran Ave, Lincoln Park 313-382-5346
18. Jill Yontz 8603 Louise, Allen Park March, 2015 [313-386-0919](tel:313-386-0919)
19. Lizabeth Bepalko 29300 Rosemont, Roseville 48066 586-776-1124

## Other DTE/CE Crime Victims

1. Matthew Williams, Clinton Twp. DTE wrecked his wood fence getting in his yard to take his analog meter. 586- 303 5225.
9. Siegred Stern, Rochester Hills, water meter changed. 248-375-1411.
3. Sue Hammel October 28. 2014 1200 El 5<sup>th</sup> St. Royal Oak.
4. John Olsen Summer of 2014 10145 W. Long Lake Rd., Alpena  
Despite protest cut off lock and swapped out meter
5. Fay Snyder Cut lock 10-14-14 2444 Otter, Warren  
When not home DTE went into yard and cut lock and replaced meter.
6. Bill Reed Feb 13, 2014 53755 Sherwood, Shelby Twp.  
When not home DTE entered yard cut lock and replaced meter.
7. Carole Garcia, Rochester Hills Has been trying to get meter removed because she is sick from radiation. Has had to move, but they installed smart meter the day she moved into her now condo.
8. Laurie Butterfield, Rochester Hills  
Has been trying to get meter removed because she is sick from radiation
9. Marge Parker 6-21-14 23002 Piper Ave  
Tricked by DTE and had lock removed and installed meter.
10. Cynthia Haas, 6 Brookline, Dearborn  
Has been trying to get meter removed because of RF sensitivity
12. Megan McHugh 12-4-14 38551 Arcola Dr., Sterling Heights  
Came on property cut lock and without permission swapped out meter.

**MICHIGAN CONSUMER PROTECTION ACT  
(EXCERPT)  
Act 331 of 1976**

**445.903 Unfair, unconscionable, or deceptive methods, acts, or practices in conduct of trade or commerce; rules; applicability of subsection (1)(hh).**

**Sec. 3.**

**(1) Unfair, unconscionable, or deceptive methods, acts, or practices in the conduct of trade or commerce are unlawful and are defined as follows:**

**(a) Causing a probability of confusion or misunderstanding as to the source, sponsorship, approval, or certification of goods or services.**

**(c) Representing that goods or services have sponsorship, approval, characteristics, ingredients, uses, benefits, or quantities that they do not have or that a person has sponsorship, approval, status, affiliation, or connection that he or she does not have.**

**(i) Making false or misleading statements of fact concerning the reasons for, existence of, or amounts of price reductions.**

**(j) Representing that a part, replacement, or repair service is needed when it is not.**

**(k) Representing to a party to whom goods or services are supplied that the goods or services are being supplied in response to a request made by or on behalf of the party, when they are not.**

**(m) Causing a probability of confusion or of misunderstanding with respect to the authority of a salesperson, representative, or agent to negotiate the final terms of a transaction.**

**(n) Causing a probability of confusion or of misunderstanding as to the legal rights, obligations, or remedies of a party to a transaction.**

**THE MICHIGAN PENAL CODE (EXCERPT)**  
**Act 328 of 1931**

**750.539d Installation, placement, or use of device for observing, recording, transmitting, photographing or eavesdropping in private place.**

Sec. 539d. (1) Except as otherwise provided in this section, a person shall not do either of the following:

(a) Install, place, or use in any private place, without the consent of the person or persons entitled to privacy in that place, any device for observing, recording, transmitting, photographing, or eavesdropping upon the sounds or events in that place.

(b) Distribute, disseminate, or transmit for access by any other person a recording, photograph, or visual image the person knows or has reason to know was obtained in violation of this section.

(2) This section does not prohibit security monitoring in a residence if conducted by or at the direction of the owner or principal occupant of that residence unless conducted for a lewd or lascivious purpose.

(3) A person who violates or attempts to violate this section is guilty of a crime as follows:

(a) For a violation or attempted violation of subsection (1)(a):

(i) Except as provided in subparagraph (ii), the person is guilty of a felony punishable by imprisonment for not more than 2 years or a fine of not more than \$2,000.00, or both.

(ii) If the person was previously convicted of violating or attempting to violate this section, the person is guilty of a felony punishable by imprisonment for not more than 5 years or a fine of not more than \$5,000.00, or both.

(b) For a violation or attempted violation of subsection (1)(b), the person is guilty of a felony punishable by imprisonment for not more than 5 years or a fine of not more than \$5,000.00, or both.

(4) This section does not prohibit a person from being charged with, convicted of, or punished for any other violation of law committed by that person while violating or attempting to violate subsection (1)(a) or (b).

**History:** Add. 1966, Act 319, Eff. Mar. 10, 1967;—Am. 2004, Act 156, Eff. Sept. 1, 2004.

## Summary

I believe the 50 resolutions and moratoriums from villages, cities Townships and even counties demonstrate that the overwhelming majority of people in Michigan believe customers deserve a educated informed decision on the cost, health, invasion of privacy and safety of any device on their property and how it will affect them, their families and community. It should be their choice!

The population of the combined cities townships and villages submitting resolutions and moratoriums is more than the 800,000 installations DTE used for the cost analysis of the AMI Opt-Out.

It must be noted that DTE did not do a study of who wanted a AMI meter even when they did the pilot program here in Michigan. They did not inquire about the Opt-Out in other states regarding the cost. This is all noted in the testimony of Robert Sitkauskas in the MPSC Case U-17053.

It is also noted that DTE sent out letters which may have influenced communities about resolutions, moratoriums and interacting with residents concerned about AMI meters and possibly denying them the awareness of opting out of AMI meters thus eliminating any cost to opt-out customers and putting the burden on AMI mandated installation.

**The following documentation comes from MPSC Case U-17053, volume 3 with the Cross Examination of Robert Sitkauskas, DTE AMI Manager by John A. Holeyton Intervener.**

1. Pages 409 line 20 to page 411 line 9, page413, line 10 to page 414 line 23 highlighted information specifically discusses DTE' effort to have communities not address the objections to AMI meters by sending out warning letters about activist coming to their communities and possibly denying them their constitutional Freedom of Speech such as what happened to Pauline Holeyton March 19, 2012 in Livonia. These paragraphs specifically address the cost ratio of 800,000 AMI installations and 1,100 possible opt-outs. This speaks of Exhibit I-JH-9 presented by myself, John A. Holeyton, through FOIA request which demonstrates DTE's initiative to send out letters to (300) communities

ALJ Mack admits Exhibit I-JH-9 as not prejudicial but related directly relevant to the cost ratio of opting out.

2. Page 421 line 15 to page 422 line 6 Highlighted information describes the question of whether DTE did a study of customers wanting a AMI meter or thought it was excellent. The question was presented to Robert Sitkauskas by ALJ Mack and the answer was NO!

3. Exhibit I-JH-8 (4) pages – List of communities DTE sent the warning letter too. This was received through discovery, MPSC Case U-17053.

4. Exhibit I-JH-9 (9) pages – DTE Letters acquired through FOIA request with different DTE employee signatures. Note original letter from Ronald Chriss actually suggest that Shelby Township Supervisor Rick Stathakis read the letter at the meeting with it highlighted in “RED”.

Recently, we have seen a small – but very vocal – minority of our customers who have expressed concerns about the meters. These individuals have been attending council meetings in a number of communities, raising questions about privacy, radio frequency waves and safety issues. For this handful of individuals – who can best be described as misinformed advocates – this is an extremely emotional issue. Their presence at municipal meetings (typically outside their own communities) is generally disruptive to the normal course of business.

DTE Energy believes there is absolutely no merit to these individual's concerns, and we remain confident in the safety, security and benefits provided by advanced meters. However, we also recognize the strong, emotional feelings these individuals have expressed, and as a result, we are developing an option that would allow individual customers to “opt out” of the advanced meter program.

We will be filing information regarding this “opt out” option with the Michigan Public Service Commission (MPSC) in March. The MPSC is the appropriate regulatory body to address this issue, and we expect some recommendation from them by this summer. In the meantime, I want you to be aware of our plans in case you hear from any individuals who may express concerns about advanced meters.

Submitted by John A. HOLETON to Energy Commission February 28, 2017.

1 MR. HOLETON: Yes, your Honor.

2 JUDGE MACK: O.K. Go ahead and ask him a  
3 question about that.

4 Q (By Mr. Holeton): Mr. Sitkauskas, do you know about  
5 Mr. Chriss and trying to inform cities and townships  
6 about misinformed advocates who are extremely emotional  
7 about the smart meter issue, their presence at municipal  
8 meetings typically outside of the communities that are  
9 disruptive to the normal course of business?

10 MR. SOLO: Your Honor, objection to the  
11 form of the question. In addition, it's  
12 mischaracterizing the document that's being sought for  
13 admission in the record. By his form of paraphrasing,  
14 the document says that this is an extremely emotional  
15 issue. It does not characterize the individuals in the  
16 way described by Mr. Holeton.

17 JUDGE MACK: Yes. You know, Mr. Holeton,  
18 the document speaks for itself. What are you trying to  
19 elicit from this witness regarding it?

20 MR. HOLETON: Well, your Honor, what I am  
21 trying to elicit from this witness is that he had missed  
22 that he has employees in DTE that are trying to go ahead  
23 and persuade communities not to go ahead and address the  
24 objections to the AMI smart meter program and who may  
25 wish to become an opt out customer who would increase

1 those numbers from 1,100 to approximately 800,000, that  
2 would cancel out any cost ratio to be discussed here at  
3 this table. And the issue of the smart meters and the  
4 smart Opt Out Program would be irrelevant. That's where  
5 I'm intending to go with it, your Honor.

6 JUDGE MACK: O.K.

7 MR. HOLETON: There are too many  
8 customers at DTE that have not had their voice heard.  
9 According to the MPSC guidelines for rate recovery,  
10 they're supposed to be reasonable rates. And a  
11 reasonable person would look at this and say lo and  
12 behold, DTE is prejudicial, trying to limit the freedom  
13 of speech, which is not an issue here because rate  
14 recovery --

15 JUDGE MACK: Hold on. You're talking  
16 argument now.

17 MR. HOLETON: Yes, your Honor. I  
18 apologize.

19 JUDGE MACK: So your contention is this  
20 proposed exhibit goes to an effort to limit the number of  
21 opt outs.

22 MR. HOLETON: Yes, your Honor.

23 JUDGE MACK: Without that, there would be  
24 more out opts?

25 MR. HOLETON: Yes, your Honor.

1 JUDGE MACK: Then that would change, of  
2 course --

3 MR. HOLETON: The whole dynamics of the  
4 cost related program with the service upfront costs. The  
5 whole thing is based on the 1,100 complaints. And by the  
6 DTE sending out these --

7 JUDGE MACK: O.K. I know. Now you're  
8 arguing. We're just dealing with the admissibility at  
9 this time.

10 MR. HOLETON: Yes, your Honor.

11 JUDGE MACK: So I've got an offer of the  
12 proposed exhibit. Anything to add besides what we've  
13 already argued on that? Mr. Solo, anything?

14 MR. SOLO: Other than a renewal of my  
15 argument that that particular line of questioning in an  
16 of itself assumes facts that are not in evidence with  
17 regard to his belief that a higher number would exist.  
18 This document says what it says and it takes a whole lot  
19 of non-record evidence to draw the conclusions that he's  
20 proposed be a part of this document here.

21 JUDGE MACK: Well, that's weight. Do you  
22 contend it's inadmissible? Do you maintain it's hearsay  
23 and it's not the type of information reasonably prudent  
24 people rely on in the course of their affairs?

25 MR. SOLO: I would argue that the first

1 the sense that I think a hearsay objection, at least to  
2 pages 4 through 9, is no longer valid. But I am  
3 concerned about the possibility that they're being  
4 offered for a purpose that you previously ruled would not  
5 be within the scope of this proceeding.

6 JUDGE MACK: Thank you, Mr. Erickson.  
7 Ms. Barone, anything?

8 MS. BARONE: Staff has no objection to  
9 that.

10 JUDGE MACK: Thank you. Mr. HOLETON, you  
11 get the last shot.

12 MR. HOLETON: Your Honor, I'm going to  
13 have to take a brief moment. Under MRE 404(b)(1), the  
14 evidence is admissible and not prejudicial if it is  
15 presented for its proper purpose and limited to an issue  
16 of fact of consequence at a trial and is sufficiently  
17 probative to outweigh the danger of unfair prejudice.

18 I'm not a legalese, your Honor, but I do  
19 believe it's highly relevant to how many customers would  
20 opt on out to this issue. It is not -- When we, I'm  
21 talking about we the people, go to these meetings and all  
22 that, we expect people to be forthright, to be a  
23 reasonable person. I believe a reasonable person would  
24 honestly believe that council members would not be  
25 listening to a corporate entity about what should be

1 discussed and not discussed at a meeting. I honestly  
2 believe that those 300 communities, had we had the  
3 opportunity and the money and benefit that DTE could put  
4 forth, having employees come to those meetings, like Mr,  
5 Sitkauskas, and sending out these e-mails, we would have  
6 a lot more opt out consumers available if we had the same  
7 opportunities as he does being paid by the ratepayers who  
8 are here today to give this testimony.

9 JUDGE MACK: O.K. Thank you, Mr.  
10 Holeton. I am going to maintain the ruling I made last  
11 week. It's my reading of these documents that they are  
12 government documents or from a party, they have some  
13 level of reliability that would allow it to come in.  
14 It's the type that reasonably prudent people would rely  
15 on in the course of their affairs.

16 I am also going to reiterate that it is  
17 not being admitted to establish some subterfuge on behalf  
18 of the Company. It is merely to go to Mr. Holeton's  
19 argument that the 1,100 meters, the 1,100 customers that  
20 Edison used as a baseline is faulty, and so therefore it  
21 is relevant cross-examination of this witness.

22 So with that, I will admit Exhibit  
23 I-JH-9. What's next, Mr. Holeton?

24 MR. HOLETON: Thank you, your Honor.  
25 Take a moment. I'm amazed I won that argument.

1 Q So it's my understanding that because there is no Opt Out  
2 Program and most of this is irrelevant, is that not true?

3 MR. SOLO: Objection, your Honor.

4 MR. HOLETON: Excuse me. I keep using  
5 that word "not". Is it true?

6 JUDGE MACK: Wait.

7 MR. SOLO: I appreciate the  
8 clarification. That wasn't the basis of my objection  
9 though, your Honor. I think he's asking for this  
10 non-attorney witness to make a determination regarding  
11 relevancy in this proceeding, which would be an  
12 inappropriate question, your Honor.

13 JUDGE MACK: Yes. What's the relevancy  
14 that you're asking this witness?

15 MR. HOLETON: Your Honor, this is --  
16 we're going back to the reasonable cost that's required  
17 for the opt out and the services and everything. Is that  
18 this whole -- Mr. Sitkauskas and DTE did a study in the  
19 Grosse Pointes and other communities, and we have not  
20 seen any documentation submitted by the Opt Out Program  
21 saying these customers thought that the program was  
22 excellent, that they would recommend it to other  
23 neighbors, other communities. I'm just wondering if Mr.  
24 Sitkauskas had presented that so we know what ratio of  
25 people that are content with the AMI program or people

1 that want to opt out for an AMI program in those  
2 communities.

3 JUDGE MACK: Well, I don't recall any  
4 testimony that they have done a study. Have you done  
5 such a study?

6 A No, sir.

7 MR. HOLETON: That's the answer I wanted,  
8 your Honor.

9 JUDGE MACK: O.K.

10 MR. HOLETON: Thank you.

11 Q (By Mr. Holeton): So I will go back to, it is also a  
12 reference that you have been to some states and discussed  
13 different rates in those communities, in those different  
14 states. But you did not go to Vermont. The basis of  
15 your making a decision is a simple analogy. You did not  
16 go to every state; you went to a few states. Is this  
17 fair to say?

18 A With respect to states visited, you're correct. I never  
19 visited Vermont. And those other states I did not visit  
20 at all for the specific request of opt out. I visited  
21 those states for other aspects of the AMI to the whole,  
22 not an individual request to that state to discuss their  
23 opt out programs.

24 Q Thank you. This brings me to the question. There are  
25 only two handfuls of states that have opt out. And smart

The Detroit Edison Company  
AMI Opt Out Program  
Case No. U-17053  
Discovery Request JHDE-1.1

<u>Communities</u>	<u>Communities</u>
Addison (Township)	Buel, Township of
Adrian (Township)	Burlington Township
Adrian, City of	Burnside Township
Algonac	Burtchville, Township of
Allen Park, City of	Canton, Charter Township of
Almer, Township of	Capac, Village of
Almont	Carleton
Almont (Township)	Carleton, Village of
Ann Arbor	Caro
Arbela, Township of	Carsonville, Village of
Arcadia, Township of	Casco, Township of
Argyle, Township of	Caseville, Township of
Armada (Township)	Cass City, Village of
Ash, Township of	Center Line
Attica, Township of	Chandler, Township of
Auburn Hills	Chelsea
Augusta, Township of	Chesterfield
Austin, Township of	China
Bad Axe	Clarkston, Village of
Bay Port	Clawson
Bedford (Township, Monroe County)	Clawson, City of
Belleville	Clinton Township
Berkley	Clinton, Village of (Lenawee)
Berlin (Township, Monroe County)	Clyde (Township, St. Clair County)
Berlin (Township, St. Clair County)	Colfax, Township of
Beverly Hills	Columbia (Township, Jackson County)
Bingham, Township of	Columbiaville
Birmingham, City of	Columbus, Township of
Blackman, Charter Township of	Commerce, Charter Township of
Bloomfield (Township, Huron County)	Conway, Township of
Bloomfield (Township, Oakland County)	Cottrellville, Township of
Bloomfield Hills	Custer, Township of
Brandon Twp	Dearborn
Bridgewater, Township	Dearborn Heights
Brighton	Deckerville
Brockway, Township of	Deerfield Township
Brookfield Township	Delaware, Township of
Brown City	Delhi, Charter Township of
Brownstown, Charter Township of	Detroit
Bruce (Township, Macomb County)	Dexter

The Detroit Edison Company  
AMI Opt Out Program  
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Discovery Request JHDE-1.1

<u>Communities</u>	<u>Communities</u>
Dryden Township	Hadley, Township of
Dundee	Hamburg
Dwight, Township of	Hamtramck
East China, Township of	Harbor Beach, City of
East Lansing, City of	Harper Woods
Eastpointe	Harrison (Township)
Ecorse	Hartland
Elba Township	Hazel Park
Elk, Township of	Highland
Elkland, Township of	Highland Park, City of
Elmer, Township of	Holly (Township)
Emmett, Township of	Howell Township
Evergreen, Township of	Howell, City of
Exeter, Township of	Hume, Township of
Fairhaven, Township of	Huntington Woods
Farmington	Huron (Township, Wayne County)
Farmington Hills	Huron, County of
Ferndale	Huron, Township of
Flat Rock, City of	Ida Township of
Flynn, Township of	Imlay City
Forester, Township of	Independence Twp
Fowlerville	Ingham, County of
Fraser	Inkster, City of
Freedom, Township of	Iosco, Township of
Frenchtown, Township of	Ira, Township of
Garden City, City of	Jackson, City of
Genoa, Township of	Jackson, County of
Gibraltar	Keego Harbor
Goodland, Township of	Lake Angelus, Village of
Gore, Township of	Lake Orion
Grant, Township of	Lake, Township of
Green Oak, Township of	Lamotte, Township of
Greenleaf, Township of	Lansing (Township)
Greenwood, Township of	Lansing, City of
Grosse Ile	Lapeer
Grosse Pointe	Lathrup Village
Grosse Pointe Farms, City of	Lenawee, County of
Grosse Pointe Park	Lenox
Grosse Pointe Woods	Leonard
Groveland Twp	Leroy, Township of

The Detroit Edison Company  
AMI Opt Out Program  
Case No. U-17053  
Discovery Request JHDE-1.1

<u>Communities</u>	<u>Communities</u>
Lexington, Township of	New Baltimore
Lexington, Village of	New Boston
Lima, Township of	Newport
Lincoln Park, City of	North Branch
Lincoln, Township of	Northville
Livingston, County of	Novi, City of
Livonia	Oakland Twp
Locke, Township of	Oakland, County of
London Township of	Oliver, Township of
Lyon Twp	Oregon Township
Macomb, County of	Orion, Charter Township of
Macon	Ortonville
Manchester, Township of	Otter Lake, Village of
Maple Valley, Township of	Oxford
Marathon, Township of	Oxford Twp
Marine City	Paris, Township of
Marion (Township, Livingston County)	Peck, Village of
Marlette, Township of	Petersburg
Marlette, Village of	Pinckney
Marysville	Pleasant Ridge
Mayfield (Township, Lapeer County)	Plymouth
Mayville, Village of	Plymouth (Township)
McKinley, Township of	Pontiac
Meade, Township of	Port Austin, Township of
Melvindale	Port Huron (Township)
Memphis	Port Huron, City of
Meridian, Charter Township of	Pte Aux Barquest, Township of
Metamora	Raisinville, Township of
Metamora, Village of	Ray, Township of
Milan	Redford, Charter Township of
Milford	Rich, Township of
Milford Twp	Richmond
Millington, Village of	River Rouge, City of
Minden, Township of	Riverview, City of
Monroe	Romeo
Monroe, County of	Romulus
Moore, Township of	Rose, Township of
Mount Clemens	Roseville
Mussey, Township of	Royal Oak
Napoleon (Township), Township of	Rubicon, Township of

The Detroit Edison Company  
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<u>Communities</u>	<u>Communities</u>
Salem	Unionville
Saline	Utica
Sand Beach, Township of	Van Buren Twp
Sandusky	Vassar
Sanilac, County of	Verona, Township of
Scio, Township of	Wales, Township of
Sebewaing, Township of	Walled Lake
Sharon, Township of	Washington
Sheridan, Township of	Waterford, Charter Township of
Sherman, Township of	Watertown, Township of
Sigel, Township of	Wayne
South Lyon	Weberster, Township of
Southfield (Township)	West Bloomfield, Charter Township of
Southgate	Westland
Speaker, Township of	Wheatland, Township of
Spring Arbor (Township), Township of	White Lake, Charter Township of
Springfield Twp	White Oak Township
St. Clair (Township)	Whitmore Lake
St. Clair, City of	Williamston
St. Clair, County of	Williamston, Township of
St. Clair Shores, City of	Winsor, Township of
Summit (Township, Jackson County)	Wixom
Superior (Township, Washtenaw County)	Woodhaven
Sylvan Lake	Worth, Township of
Taylor	Wyandotte
Trenton	Yale, Township of
Troy, City of	York, Township of
Tuscola, County of	Ypsilanti (Township)
Tyrone (Township, Livingston County)	Ypsilanti, City of
Unadilla, Township of	

**From:** Lisa Suida (lsuida@shelbytwp.org)  
**To:** w4arjohnholeton@att.net;  
**Date:** Mon, September 17, 2012 11:49:14 AM  
**Cc:**  
**Subject:** FW: FOIAs 11SEP28 and 14SEP34 (DTE)

Case No: U-17053  
Page 1 of 9  
EXHIBIT I-JH-9

Please see the attached,

*[Redacted]*

**From:** Lisa Suida  
**Sent:** Monday, September 17, 2012 11:40 AM  
**To:** 'johnholetons@yahoo.com'  
**Subject:** FOIAs 11SEP28 and 14SEP34 (DTE)

Hello Mr. and Mrs. Holeton,

Attached to this message is the response to your FOIA requests for the Smart Meter letter. Also, see the email thread below. Have a good day!

*[Redacted]*

**From:** Rick Stathakis  
**Sent:** Monday, September 17, 2012 9:30 AM  
**To:** Lisa Suida  
**Subject:** FW: AMI

**From:** Ronald E Chriss [mailto:chrissr@dteenergy.com]  
**Sent:** Tuesday, March 06, 2012 4:10 PM  
**To:** Rick Stathakis  
**Subject:** AMI

Rick ,

Please see attachment.....I believe the last few paragraphs are most important for you at tonight's meeting. I recommend you read the paragraphs I highlighted in *[Redacted]* to the audience tonight, if you feel you should.

Ronald E. Chriss  
DTE Energy  
Regional Manager  
Macomb County & Thumb Region

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As you may be aware, DTE Energy is in the process of installing advanced utility meters in a number of communities in Southeast Michigan. The meters incorporate technology that will allow them to be read remotely and provide a wide range of benefits to both residential and business customers.

This technology allows DTE Energy to:

- Quickly locate and reduce the length of power outages and other problems
- Virtually eliminate estimated bills through automated meter reading
- Remotely connect and disconnect service (including during fires or other emergencies) which means faster, less intrusive service
- Provide up-to-date information which will help utility customers track, manage and control their energy usage
- Reduce operating costs and thereby hold down future rate increases

Approximately 650,000 advanced meters have been installed in communities throughout Oakland County, as well as on Grosse Ile and Harsen's Island. Another 120,000 meters will be installed in Washtenaw County in 2012, with other communities added to the project in the future.

Recently, we have seen a small – but very vocal – minority of our customers who have expressed concerns about the meters. These individuals have been attending council meetings in a number of communities, raising questions about privacy, radio frequency waves and safety issues. For this handful of individuals – who can best be described as misinformed advocates – this is an extremely emotional issue. Their presence at municipal meetings (typically outside their own communities) is generally disruptive to the normal course of business.

DTE Energy believes there is absolutely no merit to these individual's concerns, and we remain confident in the safety, security and benefits provided by advanced meters. However, we also recognize the strong, emotional feelings these individuals have expressed, and as a result, we are developing an option that would allow individual customers to "opt out" of the advanced meter program.

We will be filing information regarding this "opt out" option with the Michigan Public Service Commission (MPSC) in March. The MPSC is the appropriate regulatory body to address this issue, and we expect some recommendation from them by this summer. In the meantime, I want you to be aware of our plans in case you hear from any individuals who may express concerns about advanced meters.

Michigan Public Service Commission  
Interveners John and Pauline Holeton

Case No: U-17053

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[REDACTED]

Page

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EXHIBIT I-JH-9

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Thanks for your attention, and don't hesitate to contact me if you have any questions.

Sincerely,



Ronald Chriss

**DTE Energy**



February 23, 2012

Jack Kirksey  
Mayor  
33000 Civic Center Dr  
Livonia MI 48154-3060

Dear Jack Kirksey:

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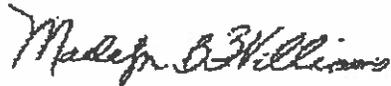
Office Of The  
MAYOR

FEB 24 2012

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Thanks for your attention, and don't hesitate to contact me if you have any questions.

Sincerely,



Madelyn Williams



February 23, 2012

Dan O'Leary  
Supervisor  
57900 Van Dyke Rd  
Washington MI 48094-2883

Dear Dan O'Leary:

As you may be aware, DTE Energy is in the process of installing advanced utility meters in a number of communities in Southeast Michigan. The meters incorporate technology that will allow them to be read remotely and provide a wide range of benefits to both residential and business customers.

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EXHIBIT  
I-JH-9  
Page - 7 of 9

Thanks for your attention, and don't hesitate to contact me if you have any questions.

Sincerely,

*Ronald E. Chriss*

Ronald Chriss

Michigan Public Service Commission  
Interveners John and Pauline Holeton

Case No: U-17053

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EXHIBIT I-JH-9

3.6

DTE Energy



February 23, 2012

Charles Bohm  
Supervisor  
64255 Wolcott Rd  
Ray MI 48096

Dear Charles Bohm

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EXHIBIT  
I-JH-9  
PAGE 9 OF 9

Thanks for your attention, and don't hesitate to contact me if you have any questions.

Sincerely,



Ronald Chriss

## **Health – How much Radio Frequency Radiation is too much!**

It is documented by the World Health Organization that cell phones maybe a possible class 2B carcinogenic. On many occasions it is recognized by DTE testimony that AMI meter's Radio Frequency Radiation, RFR, is comparable to that of cell phones and thus there may be possible negative health effects of exposure to certain Radio Frequency Radiation.

I believe it is under the false premise that DTE claims their AMI meters only expose customers with RFR once or a few times a day that customers have the legal right to limit any perceived injury and cost that may be associated with long term non-thermal radiation.

The DVD "The Cumulative Effect of Radio Frequency Radiation" demonstrates the cumulative exposures of RFR Radio Frequency Radiation including a segment of the "Troy Smart Meters" video that the AMI meters are emitting RFR approximately every minute. Provided back of book.

This is continuous RFR exposure through varying extremes, every day mandated by DTE, without the customer making an educated informed choice about a possible cancer risk.

I believe the DTE claim of AMI meters RFR exposure to be safe by meeting FCC standards is false and intentionally misleading.

The Environmental Protection Agency, EPA, has clarified that the FCC regulations for AMI meters are for the thermal effects, cooking of the skin; not the non-thermal long term exposure to RFR. There are currently no studies done on the long term cumulative effect of non-thermal exposures such as AMI meters.

I believe it is common legal practice for all parties involved that when a possible injury is contemplated, such as cancer from RFR, that all parties with that knowledge must immediately limit the injury and cost associated with that injury.

I believe all of DTE's customers should have been given a choice before installation and exposure.

## IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS

Lyon, France, May 31, 2011 – The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer<sup>1</sup>, associated with wireless phone use.

### Background

Over the last few years, there has been mounting concern about the possibility of adverse health effects resulting from exposure to radiofrequency electromagnetic fields, such as those emitted by wireless communication devices. The number of mobile phone subscriptions is estimated at 5 billion globally.

From May 24–31 2011, a Working Group of 31 scientists from 14 countries has been meeting at IARC in Lyon, France, to assess the potential carcinogenic hazards from exposure to radiofrequency electromagnetic fields. These assessments will be published as Volume 102 of the IARC *Monographs*, which will be the fifth volume in this series to focus on physical agents, after Volume 55 (Solar Radiation), Volume 75 and Volume 78 on ionizing radiation (X-rays, gamma-rays, neutrons, radio-nuclides), and Volume 80 on non-ionizing radiation (extremely low-frequency electromagnetic fields).

The IARC Monograph Working Group discussed the possibility that these exposures might induce long-term health effects, in particular an increased risk for cancer. This has relevance for public health, particularly for users of mobile phones, as the number of users is large and growing, particularly among young adults and children.

The IARC Monograph Working Group discussed and evaluated the available literature on the following exposure categories involving radiofrequency electromagnetic fields:

- occupational exposures to radar and to microwaves;
- environmental exposures associated with transmission of signals for radio, television and wireless telecommunication; and
- personal exposures associated with the use of wireless telephones.

International experts shared the complex task of tackling the exposure data, the studies of cancer in humans, the studies of cancer in experimental animals, and the mechanistic and other relevant data.

---

<sup>1</sup> 237 913 new cases of brain cancers (all types combined) occurred around the world in 2008 (gliomas represent 2/3 of these). Source: Globocan 2008

of Electrical and Electronics Engineers, Inc. (IEEE), and the National Council on Radiation Protection and Measurements (NCRP) have issued recommendations for human exposure to RF electromagnetic fields.

On August 1, 1996, the Commission adopted the NCRP's recommended Maximum Permissible Exposure (MPE) limits for field strength and power density for the transmitters operating at frequencies of 300 kHz to 100 GHz. The Commission's requirements are detailed in Parts 1 and 2 of the FCC's Rules and Regulations [47 C.F.R. 1.1307(b), 1.1310, 2.1091, 2.1093]. The FCC also presents OET Bulletin 65 to offer suggestions and guidelines for evaluating compliance. The revised OET Bulletin 65 has been prepared to provide assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to RF fields adopted by the FCC.

All Smart Meter radio devices must be certified to the FCC's Rules. Vendors develop products based on technical and regulatory specifications. Often, radio transmitters are integral parts of the meter itself, integrated into the circuit board of the device. The manufacturers test the devices to FCC specifications and then present the test results to an independent certification laboratory, or the FCC directly. Only when the FCC reviews the detailed report and certifies the device can the manufacturer market and sell the devices. The same procedures are used for Wi-Fi network equipment in PCs and wireless routers located nearly everywhere in our homes and offices.

There are two types of potential effects due to RF emissions, non-thermal and thermal. To date, there is no conclusive research that confirms negative non-thermal health impacts caused by non-ionizing RF emissions. There is, however, scientific consensus that for certain RF signal strengths there could be negative health effects. Therefore, most health studies have focused solely on the thermal effects of RF.<sup>13,14</sup> Several studies have been prepared to investigate the RF exposures of Smart Meters with relatively consistent conclusions:

- Smart Meter exposures even at close range and with exaggerated duty cycle are many times less than other household devices and are compliant with FCC limitations.
- As an example, an RF exposure comparison of a person talking on a cell phone and a person 3 and 10 feet from a continuously operating smart meter would result in Smart Meter RF exposure of 125 to 1250 times less exposure than the cell phone.<sup>15</sup>

Utility installation and operational practices and the impacts of all equipment used in the premise service location affect the exposure levels of RF greatly. Smart Meters are universally mounted in metal enclosures referred to as sockets or bases. These enclosures are generally mounted outside and facing away from the living space of a home. Single family dwellings typically have one socket located at the point of service. For multi-family housing such as apartments, condominiums, and townhouses, the sockets are a single unit with multiple meters. They are usually located in designated meter rooms, on the outside structure wall, or in the basement of high rise apartment buildings. Most of these typical mounting locations are either facing away from or are not adjacent to living areas. In addition, local fire codes and practical construction techniques limit the number of meters that are typically wall mounted, as described above for multi-family

<sup>13</sup> "Health Impacts of Radio Frequency (RF) from Smart Meters"; California Council on Science and Technology (CCST); January 2011

<sup>14</sup> "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields"; OET Bulletin 65; Edition 97-01; August; Federal Communications Commission, Office of Engineering & Technology

<sup>15</sup> "Health Impacts of Radio Frequency (RF) from Smart Meters"; California Council on Science and Technology (CCST); January 2011; page 20



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**  
WASHINGTON, D.C. 20460

JUL 16 2002

OFFICE OF  
AIR AND RADIATION

Ms. Janet Newton  
President  
The EMR Network  
P.O. Box 221  
Marshfield, VT 05658

Dear Ms. Newton:

This is in reply to your letter of January 31, 2002, to the Environmental Protection Agency (EPA) Administrator Whitman, in which you express your concerns about the adequacy of the Federal Communications Commission's (FCC) radiofrequency (RF) radiation exposure guidelines and nonthermal effects of radiofrequency radiation. Another issue that you raise in your letter is the FCC's claim that EPA shares responsibility for recommending RF radiation protection guidelines to the FCC. I hope that my reply will clarify EPA's position with regard to these concerns. I believe that it is correct to say that there is uncertainty about whether or not current guidelines adequately treat nonthermal, prolonged exposures (exposures that may continue on an intermittent basis for many years). The explanation that follows is basically a summary of statements that have been made in other EPA documents and correspondence.

The guidelines currently used by the FCC were adopted by the FCC in 1996. The guidelines were recommended by EPA, with certain reservations, in a letter to Thomas P. Stanley, Chief Engineer, Office of Engineering and Technology, Federal Communications Commission, November 9, 1993, in response to the FCC's request for comments on their Notice of Proposed Rulemaking (NPRM), Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation (enclosed).

The FCC's current exposure guidelines, as well as those of the Institute of Electrical and Electronics Engineers (IEEE) and the International Commission on Non-ionizing Radiation Protection, are thermally based, and do not apply to chronic, nonthermal exposure situations. They are believed to protect against injury that may be caused by acute exposures that result in tissue heating or electric shock and burn. The hazard level (for frequencies generally at or greater than 3 MHz) is based on a specific absorption dose-rate, SAR, associated with an effect

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that results from an increase in body temperature. The FCC's exposure guideline is considered protective of effects arising from a thermal mechanism but not from all possible mechanisms. Therefore, the generalization by many that the guidelines protect human beings from harm by any or all mechanisms is not justified.

These guidelines are based on findings of an adverse effect level of 4 watts per kilogram (W/kg) body weight. This SAR was observed in laboratory research involving acute exposures that elevated the body temperature of animals, including nonhuman primates. The exposure guidelines did not consider information that addresses nonthermal, prolonged exposures, i.e., from research showing effects with implications for possible adversity in situations involving chronic/prolonged, low-level (nonthermal) exposures. Relatively few chronic, low-level exposure studies of laboratory animals and epidemiological studies of human populations have been reported and the majority of these studies do not show obvious adverse health effects. However, there are reports that suggest that potentially adverse health effects, such as cancer, may occur. Since EPA's comments were submitted to the FCC in 1993, the number of studies reporting effects associated with both acute and chronic low-level exposure to RF radiation has increased.

While there is general, although not unanimous, agreement that the database on low-level, long-term exposures is not sufficient to provide a basis for standards development, some contemporary guidelines state explicitly that their adverse-effect level is based on an increase in body temperature and do not claim that the exposure limits protect against both thermal and nonthermal effects. The FCC does not claim that their exposure guidelines provide protection for exposures to which the 4 W/kg SAR basis does not apply, i.e., exposures below the 4 W/kg threshold level that are chronic/prolonged and nonthermal. However, exposures that comply with the FCC's guidelines generally have been represented as "safe" by many of the RF system operators and service providers who must comply with them, even though there is uncertainty about possible risk from nonthermal, intermittent exposures that may continue for years.

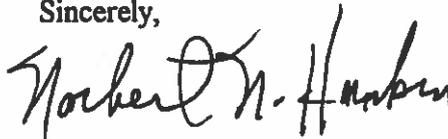
The 4 W/kg SAR, a whole-body average, time-average dose-rate, is used to derive dose-rate and exposure limits for situations involving RF radiation exposure of a person's entire body from a relatively remote radiating source. Most people's greatest exposures result from the use of personal communications devices that expose the head. In summary, the current exposure guidelines used by the FCC are based on the effects resulting from whole-body heating, not exposure of and effect on critical organs including the brain and the eyes. In addition, the maximum permitted local SAR limit of 1.6 W/kg for critical organs of the body is related directly to the permitted whole body average SAR (0.08 W/kg), with no explanation given other than to limit heating.

I also have enclosed a letter written in June of 1999 to Mr. Richard Tell, Chair, IEEE SCC28 (SC4) Risk Assessment Work Group, in which the members of the Radiofrequency Interagency Work Group (RFLAWG) identified certain issues that they had determined needed to be addressed in order to provide a strong and credible rationale to support RF exposure guidelines.

Federal health and safety agencies have not yet developed policies concerning possible risk from long-term, nonthermal exposures. When developing exposure standards for other physical agents such as toxic substances, health risk uncertainties, with emphasis given to sensitive populations, are often considered. Incorporating information on exposure scenarios involving repeated short duration/nonthermal exposures that may continue over very long periods of time (years), with an exposed population that includes children, the elderly, and people with various debilitating physical and medical conditions, could be beneficial in delineating appropriate protective exposure guidelines.

I appreciate the opportunity to be of service and trust that the information provided is helpful. If you have further questions, my phone number is (202) 564-9235 and e-mail address is [hankin.norbert@epa.gov](mailto:hankin.norbert@epa.gov).

Sincerely,



Norbert Hankin  
Center for Science and Risk Assessment  
Radiation Protection Division

Enclosures:

- 1) letter to Thomas P. Stanley, Chief Engineer, Office of Engineering and Technology, Federal Communications Commission, November 9, 1993, in response to the FCC's request for comments on their Notice of Proposed Rulemaking (NPRM), Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation
- 2) June 1999 letter to Mr. Richard Tell, Chair, IEEE SCC28 (SC4) Risk Assessment Work Group from the Radiofrequency Radiation Interagency Work Group

# Evaluation of the ITRON Open Way AMI Meter

By William Bathgate, EE, ME  
December 2, 2016

*Note: This report has been written in terms that a common person with limited knowledge of electricity and engineering can understand.*

## About the Author

### BACKGROUND: William S. Bathgate

I hold an electrical engineering and mechanical engineering degree and previously was employed through late 2015 for 8 years at the Emerson Electric Company. While at Emerson Electric I was the Senior Program Manager for Power Distribution Systems and in charge of RF and IP based digitally controlled high power AC power switching system product lines in use in over 100 countries and I was also directly responsible for product certifications such as UL, CE, PSE and many other countries electrical certification bodies. I am very familiar with the electrical and electronic design of the AMI meters in use because I was responsible for very similar products with over 1 Million units installed across the world. I have done this analysis due to my own curiosity without conflict of interest of this new technology.

I have 40 Years work experience in design and deployment of:

- High tech power management systems, UPS and power distribution
- Switched Mode Power Supplies
- Electrical and Electronic hardware engineering
- Computer systems engineering
- Radio Systems design and testing
- High Current and High Voltage switches
- Internet communications using both wired and wireless technologies
- UL, CE (Europe), Airtica, Japan, Australia and China product safety certifications
- Cyber encryption and protection of Radio Communications using digital signals
- RF/EMI mitigation

# Agenda

## Part 1 - Basic Engineering of the AMI meter

- The Opt-Out Meter and its differences from the AMI "Smart Meter"
- The Switched Mode Power Supply (SMPS) which converts 240 Volts AC to the various low voltage DC power sources for the electronics
- Electrical principles and proper SMPS design characteristics
- "Dirty Electricity"
- The Common Mode Filter and how it protects against "Dirty Electricity"

## Part 2 – ITRON Meter construction and design

- The SMPS board and characteristics and Power Sensing "Hall Effect" sensors
- The Power Disconnect up close, size of the contacts and ratings
- The Metrology System board, LCD placement, back up battery, Power Disconnect point
- The "Brains" of the meter and the two radio transceivers

2/16/2017

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2/18/2017

# Agenda

## Part 3 – Power Measurement and accuracy, design summary

- The radio transmission, frequency and signal encryption
- Privacy and Vulnerability to hacking
- The cost in kWh to run the meter, you pay to run the meter
- Meter accuracy and your bill
- Expected life of the Meter
- Overall observations and weak design areas of the Meter
- Has the investment in new AMI meters benefited the consumer?

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# Agenda – Part 1

## Part 1 - Basic Engineering of the AMI meter

- The Opt-Out Meter and its differences from the AMI “Smart Meter”
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- “Dirty Electricity”
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2/18/2017

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## Advanced Meter Infrastructure (AMI) Meters and their Switched Mode Power Supply (SMPS)



AMI Meter



Analog Meter

- What is the AMI Meter?
  - The AMI meter is commonly called a “Smart” meter and is the end point of a Smart Grid infrastructure attached to your house. The AMI end point is not required for a Smart Grid to exist. In fact the Smart Grid will take over two decades to fully deploy, but the utilities decided to deploy the AMI Meters based on incentives and payment from the Federal Government included in the Community Re-Investment Act of 2009. The useful life of the AMI meter is 5-7 years and needs to be replaced due to the aging of the electronic components. At that point all the costs will be born by the utilities and will be recompensed by the consumer in the form of higher rates. The older Analog meters which the AMI replaced are still available and have a useful life of 30-40 years and had no electronic circuits.

3/18/2017

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## Advanced Meter Infrastructure (AMI) Meters and their Switched Mode Power Supply (SMPS)



AMI Meter



Analog Meter

Each AMI meter has three electronic circuit boards and a pair of radio transceivers. In order to power the electronics and radios it requires a conversion of the 240 Volts AC power feed to lower voltage DC current via a Switched Mode Power Supply (SMPS). A SMPS is very efficient, is lower in cost and weight and have replaced the older linear power supplies that had been in use in the past.

- You likely have several SMPS in your home in your TV's, Stereos, Phone Chargers and many other electronic devices you own. Many of these devices have been tested to very stringent UL Home Use standards, some have not. The devices that do not meet the home appliance UL standards (cheaply made grow lights as an example) inject high frequency oscillations back onto the power line, which radiate through all the power wires in the home like a thousand foot long antenna, these cause human health issues and equipment failures to downstream appliances and circuits. The AMI's SMPS is the type of design that injects high frequency oscillations on the power line entering your home. There is a UL standard for AMI metering but it is very different from the Home Appliance UL standard and does not address the AMI SMPS characteristics. The ITRON AMI Open Way meter does not currently meet any UL standards at all, ITRON says it does not need to because it is not a home device, really?

2/18/2017

## SMPS with Common Mode Filter – Principles You Need to Understand

- What you need to know about the effects of applying electrical and magnetic principles
  - A SMPS utilizes a switching semiconductor (electronic chip) circuit to reduce the overall size and weight of the power supply and improves efficiency. This chip has other components that limit the amount of voltage rise in the switching circuit, these are called capacitors and can be in either cylindrical in shape, a flat or box shape. There are many other parts but these are the key components.
  - A SMPS works similarly as if you were to turn your light switch on and off at a very high frequency. The amount of voltage reaching the light would be reduced to a fraction of its full voltage illumination making the light dim. You could do the same thing with a very large resistor, but that resistor would get extremely hot very quickly, consume large amperages and waste power.

2/18/2017

## SMPS with Common Mode Filter – Principles You Need to Understand

- What you need to know about the effects of applying electrical and magnetic principles
- Whenever you switch electricity between on and off you create an electrical spike in the electrical signal that looks like a saw tooth shape waveform on an oscilloscope, this creates RF noise (static) and magnetic effects, these are called EMI/RFI leading to dirty electricity.
- When you place a voltmeter into a common house outlet the volt meter is providing an RMS measurement. RMS is an abbreviation of the term "Root Mean Square". The actual peak voltage of a common house 115-120 volt AC cycle is about 177 volts. The RMS voltage is 120 volts. Never grab a house circuit with your hands, it will kill you because you are not be able to let go of the wires, because your muscles contract and the current will not let you release yourself. Then you go in heart seizure, this is very deadly.

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## SMPS with Common Mode Filter – Health Effects You Need to Understand

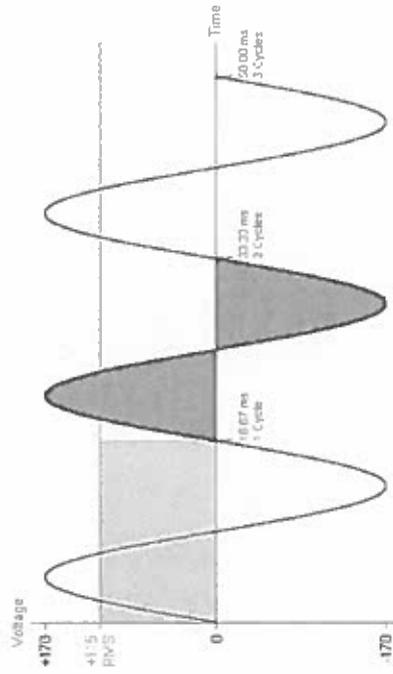
- This report is not meant to be a comprehensive review of the health effects from the oscillations present in a SMPS such as the AMI's oscillations in the form of "Dirty Electricity", but here are some important issues.
- In August 2010, in a spectacular announcement that got very little coverage, noted epidemiologist, Samuel Milham, MD linked the growth of electrification and the incidence of four of the big six diseases. In his book "Dirty Electricity: Electrification and the Diseases of Civilization." Dr. Milham connects *dirty electricity* with heart disease, cancer, diabetes, neurological disorders like ALS and suicide. See <http://www.electricsense.com/5229/dirty-electricity-electrification-and-the-diseases-of-civilization/>
- This report is not to comment on the radio emissions of the AMI meter except to say there is a lot of research and reports with the most alarming one on low level radiation direct link to cancer in the same 900 MHz frequency range used by the AMI meter and cell phones. The difference is that the cell phone can be turned off, while the AMI meter never goes off and it is on every home on the street creating a "Radio Soup" environment you cannot get away from.

The National Toxicology Report found here at <http://biorxiv.org/content/early/2016/06/23/055699.full.pdf+html>

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## SMPS with Common Mode Filter – Principles You Need to Understand

The Standard Single Phase 60 Cycle/Second 115 -120 Volt AC Power Oscillation Waveform



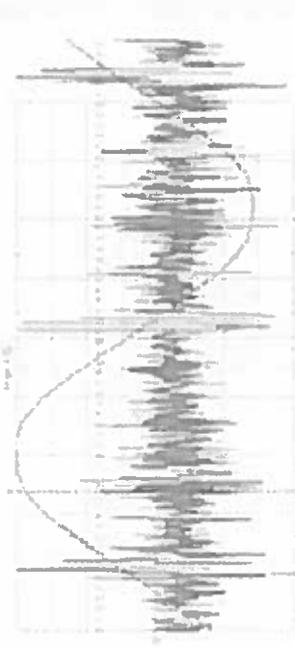
This waveform displayed is the same as an oscilloscope trace would look like, you cannot see this on a common voltmeter you would only see the reading of 115-120 volts RMS

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## SMPS with Common Mode Filter – Principles You Need to Understand

The Standard Single Phase 60 Cycle/Second Waveform with EMI/RFI introduced by the SMPS

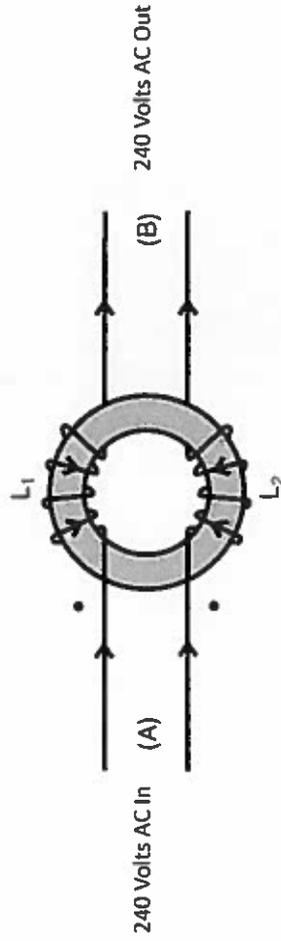


This waveform displayed is the same as an oscilloscope trace would look like, you cannot see this on a common voltmeter. Now we have introduced the effects of EMI/RFI to the same wire carrying the house current. This effect can be better depending on the environment especially how good the house earth ground is magnetically coupling the house voltage currents. There are many variables that affect this waveform. The image in red should never be there, I have found this pattern consistent with every AMI meter, including the AMI meter with the radios off.

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## SMPS with Common Mode Filter - Example

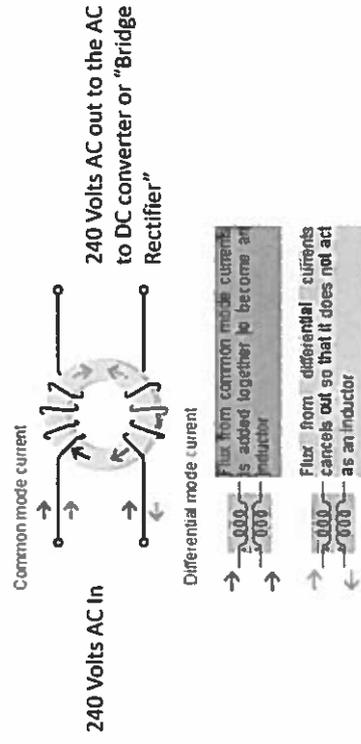


Please note the magnetic component is made of compressed iron ferrite and is shown here as a donut shaped image just to simplify the representation, but this can be accomplished via a magnetic shaped bar also and does the same thing. The number of windings on the donut are the same on both sides. It is a type of device called a choke filter.

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## SMPS with Common Mode Filter - Example

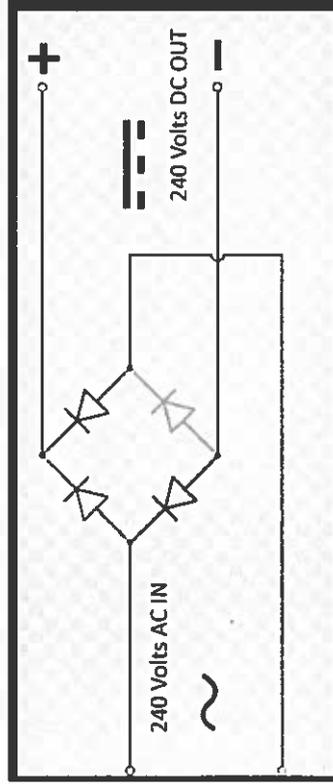


In this simplified representation it is very important to note that AC current flows in and out, it is bi-directional. Therefore any oscillations created by the switching circuit cancel each other out via counter acting magnetic flux within the ferrite core.

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## SMPS with Common Mode Filter – Example – AC to DC Converter

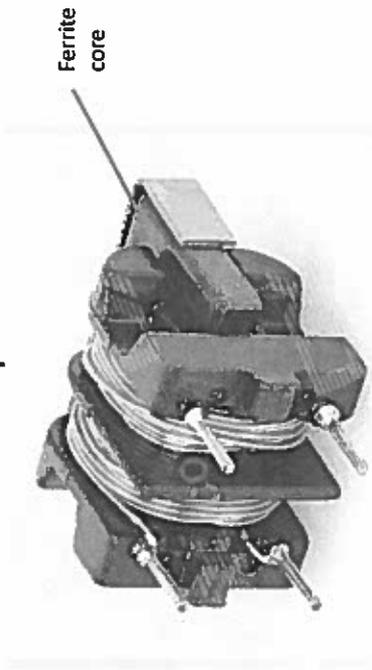


In this representation it demonstrates how you turn AC voltage into DC voltage. This is called a diode bridge and only allows one way flow similar to a check valve in plumbing you need 4 of them and it is termed as a "Bridge Rectifier"

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## SMPS with Common Mode Filter - Example



Here is an example of a common mode filter that does the same job as a donut shaped filter, here the ferrite core is in the center of the coils and is shaped as a square bar. This part cost \$0.73 per piece in lots of 1,000

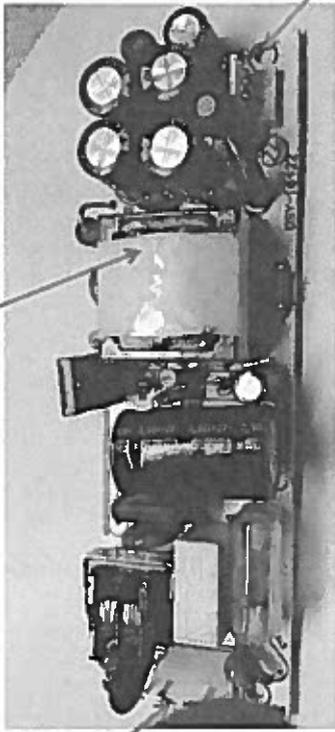
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## SMPS with Common Mode Filter - Example

Please note this is an example of a UL approved 240 Volt AC to 24 Volt DC SMPS. This design does not inject high frequency oscillations onto the incoming AC line because it has a common mode filter circuit (left hand side of the circuit board)

Transformer that converts 240 volts to 24 volts



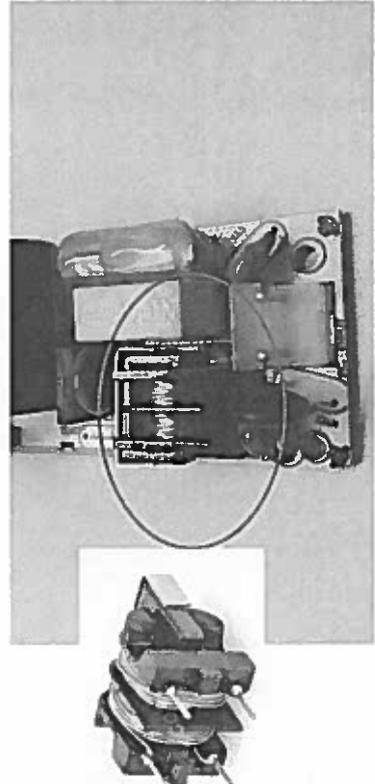
Note the DC Out has + - and a ground lead (center) which is connected to a true ground

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## Common Mode Filter - Sample

Please note this is an example of the Common Mode Filter in the design example



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## Agenda – Part 2

- Part 2 – ITRON Meter construction and design
  - The SMPS board and characteristics and Power Sensing “Hall Effect” sensors
  - The Power Disconnect up close, size of the contacts and ratings
  - The Metrology System board, LCD placement, back up battery, Power Disconnect point
  - The “Brains” of the meter and the two radio transceivers

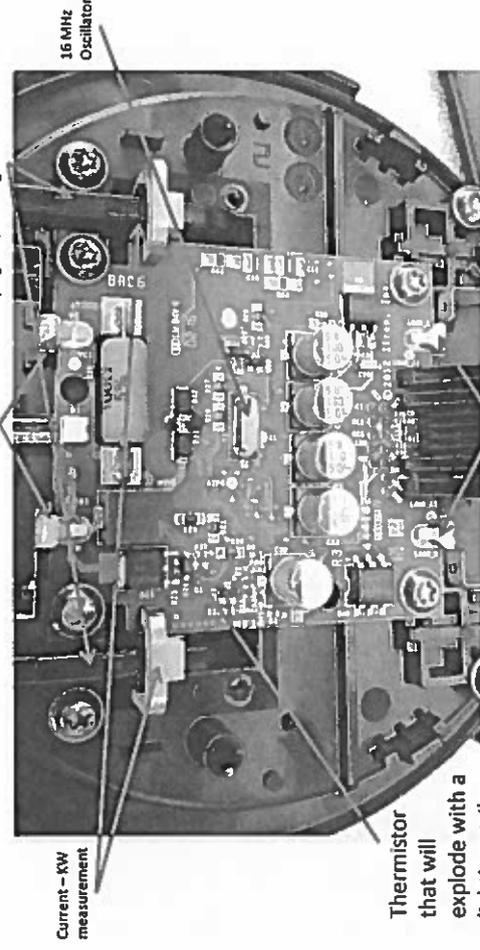
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## The ITRON Meter SMPS Board

Note under this plastic is the current carrying tab, if this gets hot it melts

240 Volts IN



Current - KW measurement

16 MHz Oscillator

Thermistor that will explode with a lightning strike or power surge

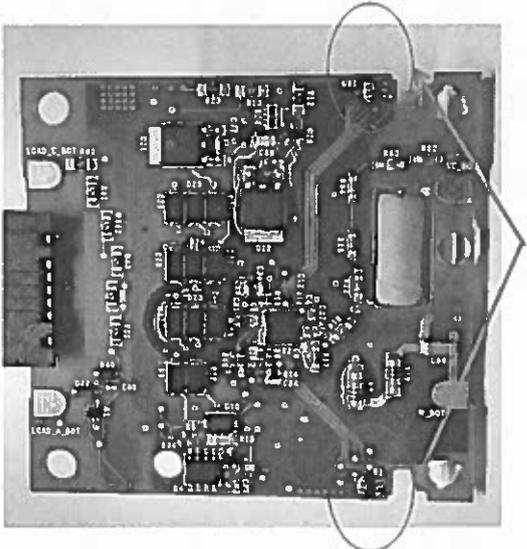
240 Volts OUT

You will notice that there is no common mode filter circuit at all

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## The ITRON Meter SMPS Board – Back Side of Board

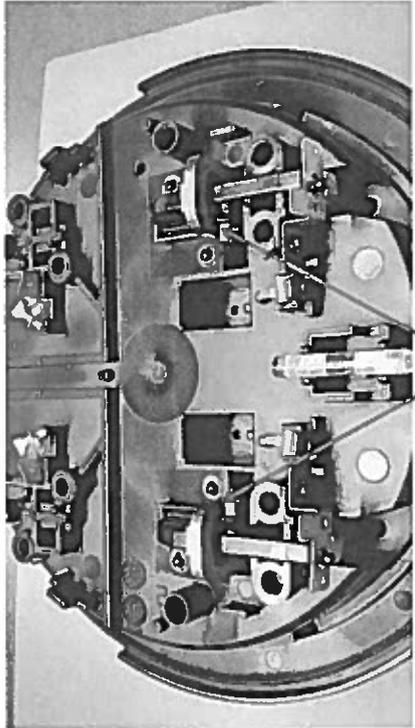


Here are the hall effect sensors that are used to measure Current/kWh

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## The ITRON Meter SMPS Board – Mounting Location



Here are where the hall effect sensors that are used to measure Current/kW are placed

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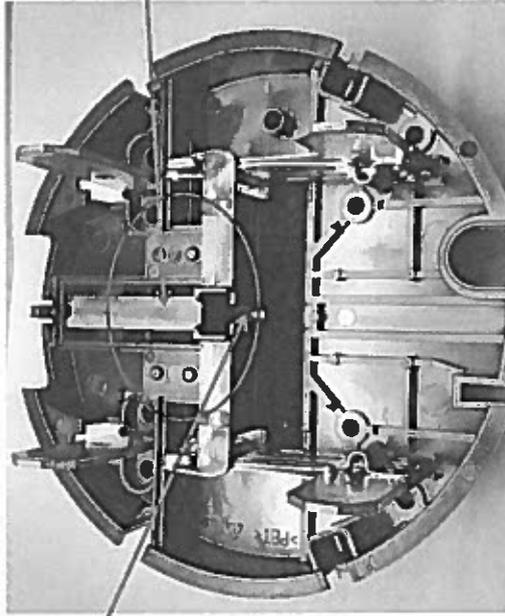
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## The ITRON Meter Power Disconnect



24 Volt  
Power  
Disconnect  
Solenoid

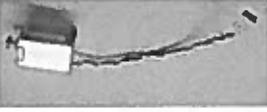
If you slide this plastic lever (with the notch in it) you break the contacts and shut off your power



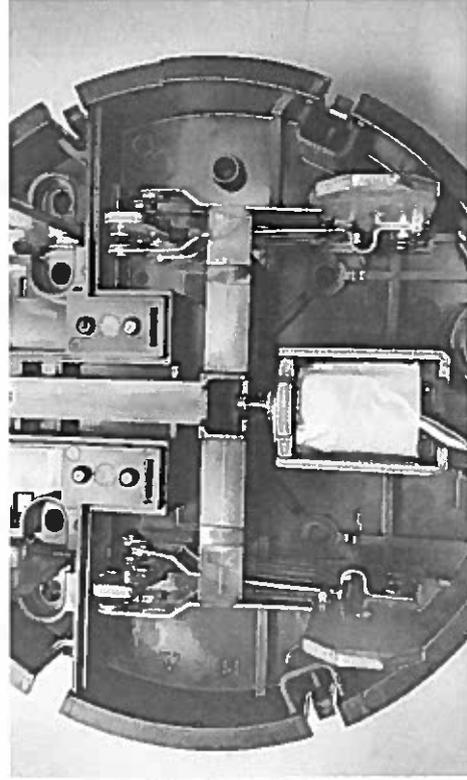
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## The ITRON Meter Power Disconnect



24 Volt  
Power  
Disconnect  
Solenoid

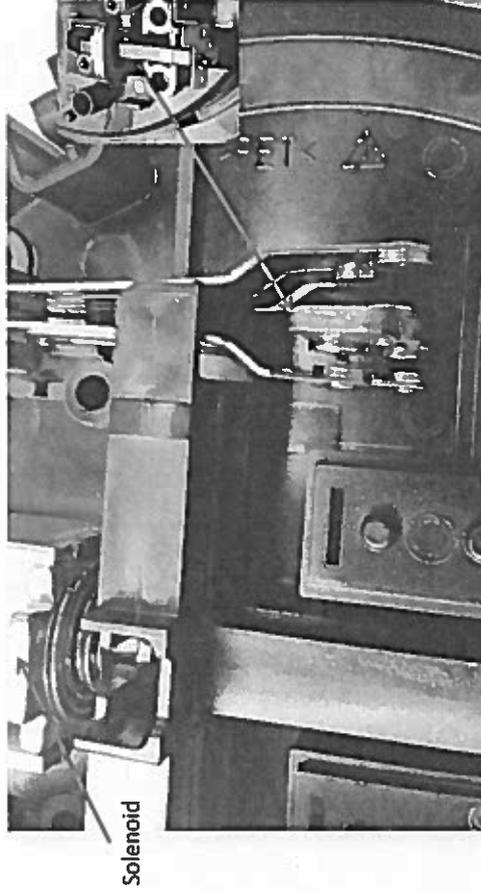


If you slide this plastic lever (with the notch in it) you break the contacts and shut off your power

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## The ITRON Meter Power Disconnect



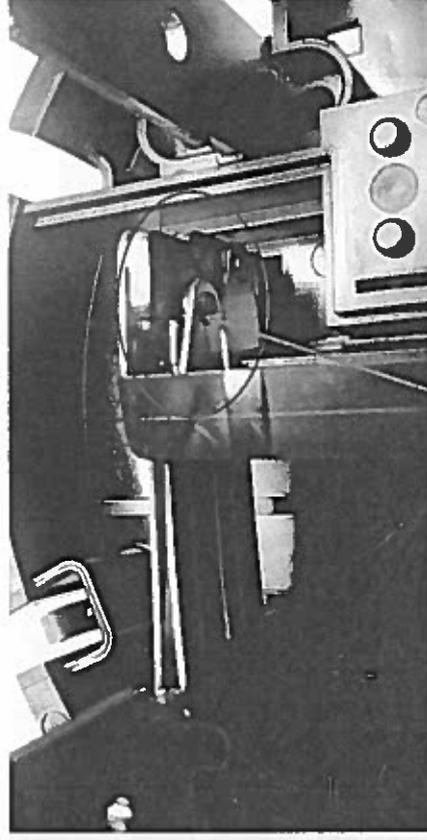
Solenoid

In this photo the contacts are broken from activating the solenoid against the plastic lever, there are four contacts . The vertical metal piece is aligned to the hall effect sensors on the power supply board and is encased in plastic .

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## The ITRON Meter Power Disconnect

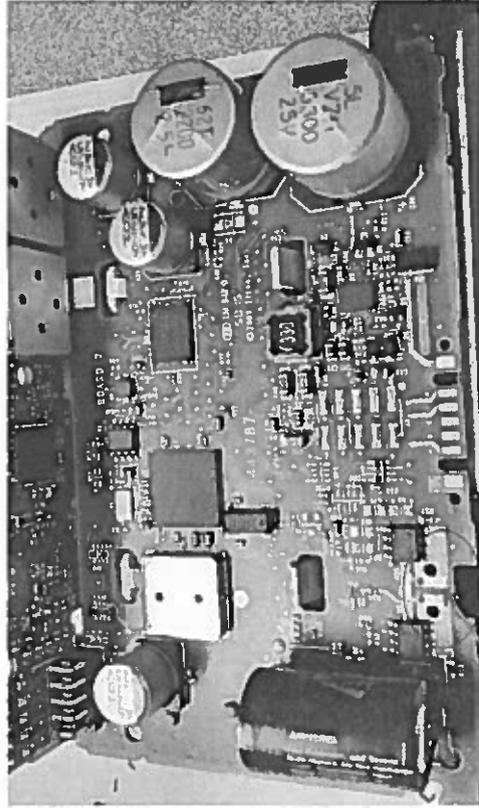


In this photo the contacts are shown from the sliding the plastic lever I will note that these contacts are relatively small and would not likely be able to withstand 200 AMPS full load. Perhaps 40 AMPs. For comparison the Landis+Gyr meters have three contacts and are 3x the size

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## The ITRON Meter System Board



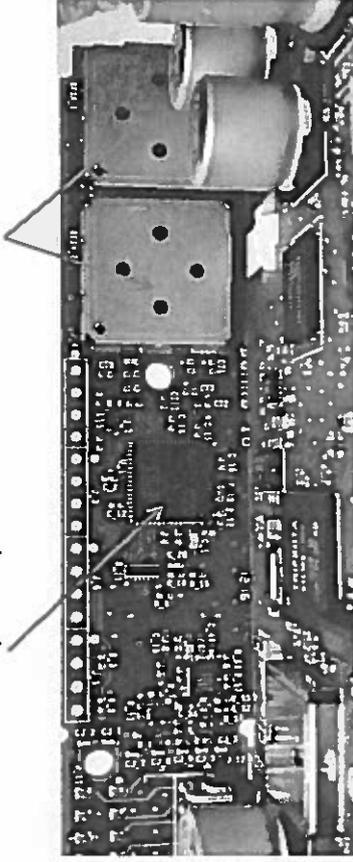
To the disconnect solenoid (24 v)

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In this photo is the memory board and additional voltages for the disconnect solenoid (24 V) and is used for the LCD display (on Back of this board)<sup>27</sup>

## The ITRON Meter Computer and RF Transceiver Board

The ARM Computer Chip

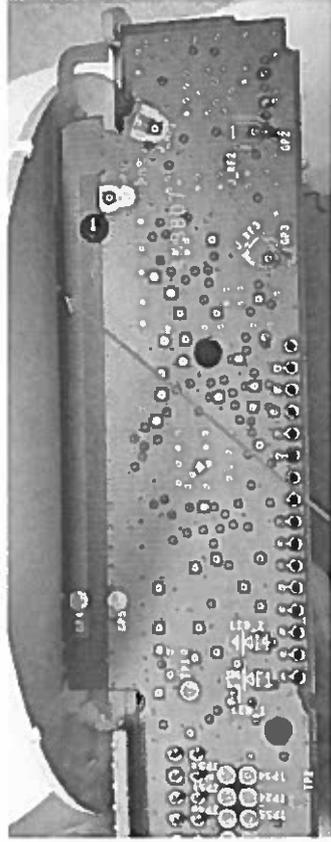


In this photo is the computer chip (ARM Chip) board and the two transceivers

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## The ITRON Meter Computer and RF Transceiver Board



In this photo is the antenna for the two transceivers, they share the same circuit board trace as the antenna, the white plastic holds the LCD display.

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## Agenda – Part 3

- Part 3 – Power Measurement and accuracy, design summary
- The radio transmission, frequency and signal encryption
  - Privacy and Vulnerability to hacking
  - The cost in kWh to run the meter, you pay to run the meter
  - Meter accuracy and your bill
  - Expected life of the Meter
  - Overall observations and weak design areas of the Meter
  - Has the investment in new AMI meters benefited the consumer?

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# ITRON Radios Characteristics

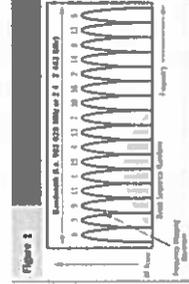
- 1st Radio Signal
  - Power rating at the meter in an isolated environment is within FCC specifications of less than < 1 Watt at "Unity" gain in the spec FCC Part 47.15
    - Radio transmissions are allocated by the FCC in what is called the radio spectrum. This is typically stated as the wavelength of resonance, similar to piano tuning forks which resonate as a particular sound frequency based on its length of the forks. Antennas are usually stated in the frequency of resonance and gain.
      - This meter's 1<sup>st</sup> radio operates in the 33 CM radio spectrum which is between 902-928 MHz. 33cm is called the full wavelength which about 12.99 inches long. Wavelength is important in that to fully "hear" the signal you need an antenna that is 1/2 or 1/4 of the full length or typically some even fraction of the full wavelength. Such as 1/2 or 1/4 of the full wavelength. The antenna in the ITRON meter is 1/4 wavelength or about 3.25 inches long.
      - It uses a "Spread Spectrum" technique and sends "packets" of information.

FCC Frequency Allocation

Service	Frequency Range (MHz)	Power Limit (Watt)	Modulation	Notes
Fixed Service	1.6-1.7	1000	AM	
Field Distribution Systems	1.7-1.8	1000	AM	
NAVY	1.8-1.9	1000	AM	
Mobile Land to Shore by Characteristics of A, U, and V	1.9-2.0	1000	AM	
Emergency Control Signals	2.0-2.1	1000	AM	
Parabolic Transmission	2.1-2.2	1000	AM	

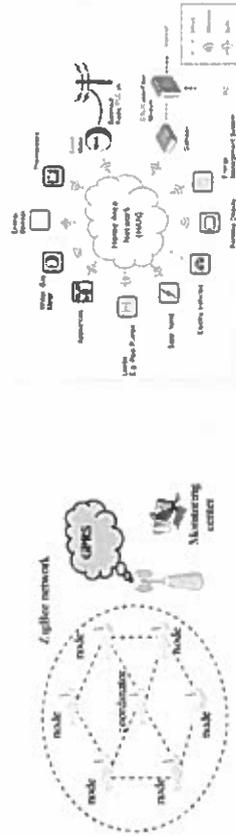
# ITRON Radios Characteristics

- Frequency Hopping Radio Signals
  - "Spread Spectrum" is a frequency hopping technique invented by the famous 1940's actress "Hedy Lamar" and sends "packets" of information. It was developed to foil the enemy radio signals from blocking our proximity sensing anti-aircraft shells in WWII.
    - Frequency Hopping is a technique to avoid collisions of transmitted signals, so the first packet of data will be sent to a random channel in the frequency range. If it senses that there was a collision it shifts the frequency until it is successful in sending the data packet, then the process starts all over again for the next packet. Packet size can vary from 576 bytes to 1500 bytes, ITRON does not disclose the packet size it uses. As the number of AMI meters increase the signal experiences a lot of collisions causing retransmissions
      - The number of transmissions increases as the number of nodes in the network increases, the result is a type of radio immersion of the entire neighborhood, sometimes called a "Radio Soup" environment leaving no safe harbor from the microwave radiation.
      - Packets are sent approximately every 4-5 seconds all day based on observations of readings. The daily upload of the meter data usually occurs each night taking from one to two hours long.



## ITRON Radios Characteristics

- ZIGBEE Home Area Network (HAN) Radio Signal
  - Encrypted Packet Radio Network (GPRS), @2.4GHz radio frequency
  - Uses a Mesh Network topology similar to the AMI meter's 902-928 MHz radio
  - Also uses a gateway to your home network router
  - The ITRON Meter acts as the coordinator, therefore you need to contact the utility to register each device you add to include them in the HAN network
  - The packet size is 127 bytes
  - Coordinator power levels are up to 1 Watt, though mostly 0.4 Watts



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## ITRON Meter Vulnerability

- Can the radio signals be hacked?
  - The 902-928 MHz and the HAN ZIGBEE 2.4 GHz radio packets are AES 128 encrypted with a ECC-256 bit key. Therefore it is unlikely that a hacker would take the steps needed to directly attack your home. It would not gain them anything financially.
  - The Collector which is the most vulnerable component (Weak Link) is the regional repeater/collector. While this device cannot be easily hacked, it can be attacked. I do not condone in any way any actions but any terrorist group can obtain a shotgun and disable it by shooting it. It is unclear what individual homes would experience regarding their power, it may cause a massive power shutdown due to a "false Positive" to a tampering of the meter.
  - Another method would be to design a broadband RF interference transmitter operating at >30 Watts and flood the repeater with signals so it cannot collect data.
  - The highest vulnerability is within the utility data center, utilities are attacked frequently by hostile foreign countries and criminals and there are few exceptions.



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## ITRON Meter Vulnerability

- Privacy - Can your personal information be hacked?
  - The 902-928 MHz radio sends personal usage on a 15 minute interval to the utility. The signal can determine if you are at home, when you use your power the most, and whether the load is resistive (Light Bulbs) or inductive (electric motors).
  - With the Energy Bridge device they can determine the model number and serial number of the appliances you have, turn off your appliances remotely without your permission and share your personal information with third parties you will not be able to control. They also can connect to your Smart TV and scan what TV shows you watch and report that to third parties. With a Smart TV they can actually listen to your conversations. Spam and fishing attacks will likely expand
  - With the Energy Bridge device they can connect to your home network router and listen to your internet traffic such as VOIP phone conversations, emails, streamed downloads etc. Since they will be directly connected to the router via a wired connection and do not need encryption to detect the traffic.
  - Each Meter also has a infrared LED at the top which flashes more frequently as you use more power. If you have a night vision goggle you can readily see this. Police can use this as an indicator of a possible illegal drug growing indicator. Thieves can use this to determine if a house is not occupied at the time.



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## Meter accuracy and your bill

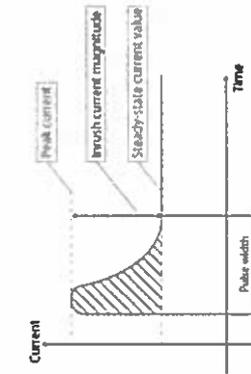
- The AMI meter is "accurate" based on the Navigant Consulting Report in 2010 and referenced on the ITRON web site. However within this report the extremely high rate of billing complaints after the installation of the new meters is evident and explanations were difficult to verify as to their cause. The number of complaints was dramatic. This test was done in Texas with temperature ranges from ~30 to ~88 degrees.
  - Control testing conditions were not well explained in this report, in particular the type of load the meter accuracy was compared to.
    - Resistive loads such as light bulbs
    - Inductive loads such as electric motors
    - No discussion on how the meters did the kWh calculation, with averaging of samples over a fixed period of time?
  - The meter electronic sensor used to calculate power is called the "Hall Effect Sensor" in the AMI meter versus the "Eddy Current" sensor in the Analog meter. Both methods are accurate and within ANSI standards of 2%. What is very different in the AMI meter is the algorithm used to calculate the readings from the sensor into the indicated display. The analog meter is a type of "totalizing" meter just like a gas pump. The AMI meter uses sensor data, which has to be averaged by a mathematical calculation and then registered into memory and on the LCD display. The gas pump has a weight and measures standards sticker to assure the Consumer they are getting what they paid for, there is no such concept on an AMI meter.

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## Meter accuracy and your bill

- Navigant Consulting's Report in 2010 is referenced on the ITRON web site. But there were two different meter manufacturers ITRON and Landis+Gyr. The report did not differentiate performance characteristics between manufacturers
- The Navigant Report tried to explain the billing inaccuracies using complex mathematical explanations and reference to "degree" days but the degree variance was typically within 10% year over year, yet this did not explain power bills increasing as much as 25%-40% higher year over year.
- Their test lab control set setups were done at room temperatures as shown in pictures in the report
- There was no field test at various temperatures for accuracy



- Electric Motor Current Draws are different than a light bulb
- There is a short .5 to .6 sec burst of current needed to start an electric motor, so a 5 amp rated motor may need 8-9 amps to get rotating up to rated speed
  - If the utility is measuring peak current and averaging this over a window of time you can skew the average when you combine the two types of loads.
  - Only the utility knows the math in the software
  - If you have "Energy Star" refrigerator/freezer it starts and stops frequently, and so the skew of the average is worse, imagine the impact on the average reading after 3-5 motors start and stop in the sample window.

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## Meter accuracy and your bill – Power Required to Run the AMI Meter

Data Source – DTE Energy Insight Phone Application

Test Conditions: Main breaker ON, All branch circuits OFF

Home Unoccupied – Skipped dates are from periods when we were moving into the home and we excluded any dates when we needed to turn on a light bulb

Date	kWh Consumed by the AMI Meter
October 17, 2016	1.8 kWh
October 18, 2016	3.0 kWh
October 19, 2016	2.2 kWh
October 20, 2016	3.2 kWh
October 21, 2016	2.1 kWh
October 25, 2106	2.4 kWh
October 26, 2016	2.2 kWh
October 27, 2016	2.1 kWh
October 28, 2016	2.3 kWh
Average Daily AMI kWh Use	2.37 kWh @ 0.13 per kWh = \$0.31

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## Meter accuracy and your bill – Power Required to Run the AMI Meter

Based on real collected data, not extrapolated calculations

- At ~ \$.31 per day cost just to run the AMI meter this equals an added \$113.15 per year per customer
- If you consider the total annual AMI kWh use for the 2.1 M DTE customers this is an added \$2,383,500,000 in added revenue to DTE to run the AMI meters, fully paid by the customer base
- If you also consider the Annual kWh consumed by just running the AMI meters in the 2.1 Million Customers in the DTE territory this equals an added 1.816 Billion kWh in required added generation capacity demands just to run the AMI meters.

**Conclusion:** There is absolutely no evidence the AMI Meter program saves energy in kWh or money, in fact it only drains the bank accounts of the consumer and pads the revenue of the utility.

The only way the AMI program will save kWh's is to use it to ration power to consumers via Demand Response/Time of Use rate structures at 400-700 X normal rates where the elderly, disabled and young families with a parent and small children at home can least afford it or do without power during the Demand Response/Time of Use period. Under this scenario the AMI program is the largest fleecing of the consumer to ever exist.

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## ITRON AMI Meter Life Expectancy

- New to the home consumer is the deployment of an electronic power meter on the exterior of the home. There is no realistic expectation that these new meters will last 20 years of more.
- The miniaturization of electronics constantly leaps forward in reducing the size of an electronic design. This causes the industry to obsolete certain logic chips sets within one or two years from the date of the original start of manufacturing.
- With obsolescence comes the risk that direct replacement of a meter after 2 years with the same components is unlikely or the required software compatibility will be restrained.
- Electronic circuits do fail under the extremes of temperature and humidity. The meters are not hermetically sealed to keep out dust and moisture. There are conformal coatings on the circuit boards which indicates they had issues with moisture on the chip sets in the past, the whole board is not covered with a conformal coating but only on special areas.
- The number of incoming power surges hitting the Varistor on the power supply board will degrade this component over time to where it no longer protects the circuit and increasingly permits power line quality issues to enter the circuit boards. This can cause an exacerbation of the "Dirty Electricity" issues already present or circuit board failures .
- The LCD will be hard to read after exposure to temperature extremes and humidity in less than 5 years. LCD's are very sensitive to low temperatures, and they dim considerably below 0 ° F

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## Overall Observations of the ITRON Meter

- After a hard look at the design and construction of this ITRON meter there are the following observations

- The biggest weakness is in the power disconnect, it suffers from a small surface area for the disconnect contact and would be prone to excessive heating and likely result in contact pitting and carbon deposits that are not readily visible by the customer and there is not a sensory circuit that could detect it and report it to the consumer or the utility. This design would be prone to creating unpredicted fires.
- The second weakness which is causing thousands to become ill is the lack of a common mode and differential filtering of the SMPS oscillations being injected from the meter onto the house wiring circuit, thus making the whole house into an antenna with dangerous RFI/EMI. Overall costs for the needed components would be around \$1.50 per meter/circuit board. There are ways to design a SMPS without these filters but this design would need to have a solid ground reference to earth, but this meter design and construction does not permit an earth ground so this scenario is unfeasible.
- The power required to run the AMI meter is borne by the homeowner, this was never disclosed to the public that their bill will go up by over ~\$115.00 per year just to power the meter. Also the added load on generating capacity was never used in the justification for the investment required for the deployment of AMI. This gives a false impression on the AMI program reducing energy consumption. It does not save any energy for the consumer or the utility. The current Analog meter does not cost the consumer or the utility any energy to power it.

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## Overall Observations of the ITRON Meter

- Additional observations
  - The privacy and security of the full AMI program is another exposure that has not been fully disclosed to the consumer. The broad based scenario of incorporating the Internet of Things (IoT) in the home environment and linking it to a meter creates increased exposure of personal information to third parties without consent. The fact that the consumer agreed to the service agreement of the utility for provision of electricity also implies the the consumer has by default agreed to the disclosure of personal information to places not named should be a large concern. Image if this was the case when you buy gas for your vehicle. Should the gas provider require you to ID the type of vehicle you are driving before the gas pump is tuned on?
  - The utility consistently states the RF emissions of the meters meet FCC requirements, this is a misleading statement, FCC requirements are for the effects of enough ionizing power to cause the brain to heat up 1° C. There have been over 800 peer reviewed independent studies not funded by the industry that have linked this type of low level non ionizing RF radiation to a group of diseases including brain cancer, Parkinson's, Alzheimer's, high blood pressure, Tinnitus, skin rashes and open sores as an example. Industry funded studies do not concur with these findings so this adds to confusion on the health effects attributed to the meters. I have personally met many of the affected consumers and this is no joke or set of psychological conditions.
  - The fact that there is a set of circuit boards in a power meter at all is a large risk, the circuit boards would not be able to withstand a lightning strike or a power surge without an explosive reaction and likely melting of the circuits. This would lead to total destruction of the unit and lead to a possible fire.

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## Has the investment in new AMI meters benefited the consumer?

- The utility is passionate about the need for AMI. Their primary benefits are:
  - Reduction in meter reader workforce costs
  - The has been no rebate or discount to the consumer for this savings the utility gains, where did this savings go?
  - Ability to monitor the expense of outages
  - This may marginally benefit the consumer but communications of their outage existed before via phone anyway. However the savings to the utility has never been remunerated and returned to consumers.
  - Ability to turn off services to non paying consumers without out a "Truck Roll"
    - This will save the utility money, yet the savings are not passed on to the consumer, every time a truck roll is avoided the utility should be sending a check equal to that costs savings to the consumer base.
  - Ability to save energy
    - The AMI meters themselves increases demand for energy capacity and costs the consumer "115.00 per year in added costs they were never told about. In addition there is a question of fairness in reporting how inductive loads are calculated in the meter readings. The lack of transparency in the data manipulations for inductive loads versus resistive loads has never been elaborated by the utility.
    - The only way this will save energy is to require 100% compliance to Time of Use/Demand response to ration power to consumers. Demand Response policies have never been explained and enumerated to the consumer and many of these policies are already in the pipeline. Federal law requires that if DR is made available in a service area it is to be 100% enforced.

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## Has the investment in new AMI meters benefited the consumer?

- Ability to incorporate alternative energy sources
  - This only applies to the utility. The utilities are blocking consumers the ability to sell back to the grid. The utilities have increased their rates to build alternative energy sources and increased their billing to pay for these facilities. However they are also charging the current rates to the customer for what they now obtain for free.
- Ability to dynamically manage energy demands
  - The use of a network topology for meter reading is a benefit to the utility to possibly obtain real time information to match capacity to demands. However the AMI system is only communicating power consumption on a daily basis so how is this to become a real time system unless the AMI meters begin transmitting demand at an almost constant rate. This has never been communicated to the consumer. The load of data collected if in a real time system would overwhelm the ability to process the data. If the intent is managing capacity to demand is the reason for deploying AMI then collecting the data once a day will not ever accomplish the goal to match capacity to demand. This is the critical flaw in the AMI concept at the point of use and the whole reasoning to deploy AMI and fails to accomplish this goal of dynamically managing the grid when only collecting data once a day. Since the AMI enabled Gas meters rely on the electric AMI meter, and the AMI electric meter justification is dubious with only daily readings the sum of the benefits of AMI is only related to elimination of manual meter readers, which has not resulted in any consumer savings.
- The need for AMI to reduce energy consumption
  - The most recent report from Michigan LARA estimate from 2014-2015 year predicts residential electric energy consumption as flat, with commercial consumptions reducing and industrial sectors growing by 3 % with a combined increase of 0.8 %. The revised report for 2016-2017 still states the growth as lower than historic values. Why do we need hundreds of millions of added costs to support a flat demand curve? Is this a solution looking for a problem?

2/16/2017

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**BACKGROUND:**

I hold an electrical engineering and mechanical engineering degree and previously was employed through late 2015 for 8 years at the Emerson Electric Company. While at Emerson Electric I was the Senior Program Manager for Power Distribution Systems and in charge of an RF and IP based digitally controlled high power AC power switching system product line in use in over 100 countries and I was also directly responsible for product certifications such as UL, CE, PSE and many other countries electrical certification bodies. I am very familiar with the electrical and electronic design of the AMI meters in use because I was responsible for very similar products with over 1 Million units installed across the world. I have done this analysis due to my own curiosity without conflict of interest of this new technology.

I have 40 Years work experience in design and deployment of:  
High tech power management systems, UPS and power distribution  
Switched Mode Power Supplies  
Electrical and Electronic hardware engineering  
Computer systems engineering  
Radio Systems design and testing  
High Current and High Voltage switches  
Internet communications using both wired and wireless technologies  
UL, CE (Europe), Africa, Japan, Australia and China product safety certifications  
Cyber encryption and protection of Radio Communications using digital signals  
RFI/EMI mitigation

**Relative to comments to the following 3 questions:**

First a couple of clarifications are in order - the AMI radiating meter and the non-radiating meter are identical in all respects. They have the same components, boards, housing etc. The Opt-Out meter is the same as the non-Opt-Out meter in all respects, the Opt Out Meter is configured with the radios turned off or "deactivated".

The AMI meters have two radio transceivers; one operates in the same frequency of a cell phone or microwave oven of ~900 MHz, which is for a link to the utility and the second radio operates in the same frequency as a wireless home router or a PC at ~2.4 GHz. The 900 MHz radio transmits between .6 to 1.0 watts depending on the installed surrounding conditions, such as reflective surfaces nearby like bouncing off a neighbors home walls. The ~2.4 GHz is called a Home Area Network (HAN) that operates at .25 to .40 watts depending on the surrounding surfaces. The HAN is intended to permit connection of the AMI meter to the home internet devices such as Wi-Fi thermostats and Wi-Fi enabled home appliances.

### **1. Question: If a "deactivated" meter can be turned on remotely**

Answer: By deactivated I believe you are referring to the two Transceivers (a transceiver is both a transmitter and a receiver) within the ITRON AMI Meter. Only the transmit function is turned off, but the receive function is not ever turned off. To accomplish this the source of power for these two circuit chips would have to be cut off. If this was done to the meter it would no longer function at all because the CPU (Central Processing Unit-Brain for circuit board) for all the functions of the meter are on the same circuit board as the radio circuits. So the answer is yes.

It is important to understand the receive function is always on and can receive a command to re-enable the transmit function on both radios anytime by the utility without sending out a tech on site. The radios from one meter talks to a neighboring meter which then talks to another neighboring meter, by sending the waves through all homes in the neighborhood. This is very dangerous to people who are sensitive to radio frequencies (RF). The utility can use this network connection to re-activate the meter. This can all be done without the customer being aware of it.

Proof of this capability is demonstrable when a home that has the Opt-Out AMI meter installed is transferred to a new owner/occupant, suddenly the Opt-Out meter becomes a regular radiating meter without a tech from the utility going to the home. A conventional analog mechanical meter does not have the ability to broadcast.

### **2. Question: If a "deactivated" meter is still broadcasting**

This is not a question that allows for a simple yes or no answer. The utilities can send a signal 24/7 to any deactivated meter and the meter will broadcast back to the utility any information they request.

### **3. Question - Any other reasons a deactivated meter is bad (with proof)**

Answer: Both AMI meters inject a pair of interfering voltages overlaid on to the standard 60Hz (in Light blue)

This interference is called Radio Frequency Interference and Electromagnetic Interference called RFI and EMI. This RFI/EMI is the result of a defective design of the Switched Mode Power Supply in the AMI meters which is used to power the electronics. This power supply is used to convert the 240 Volts AC to the various DC voltages required.

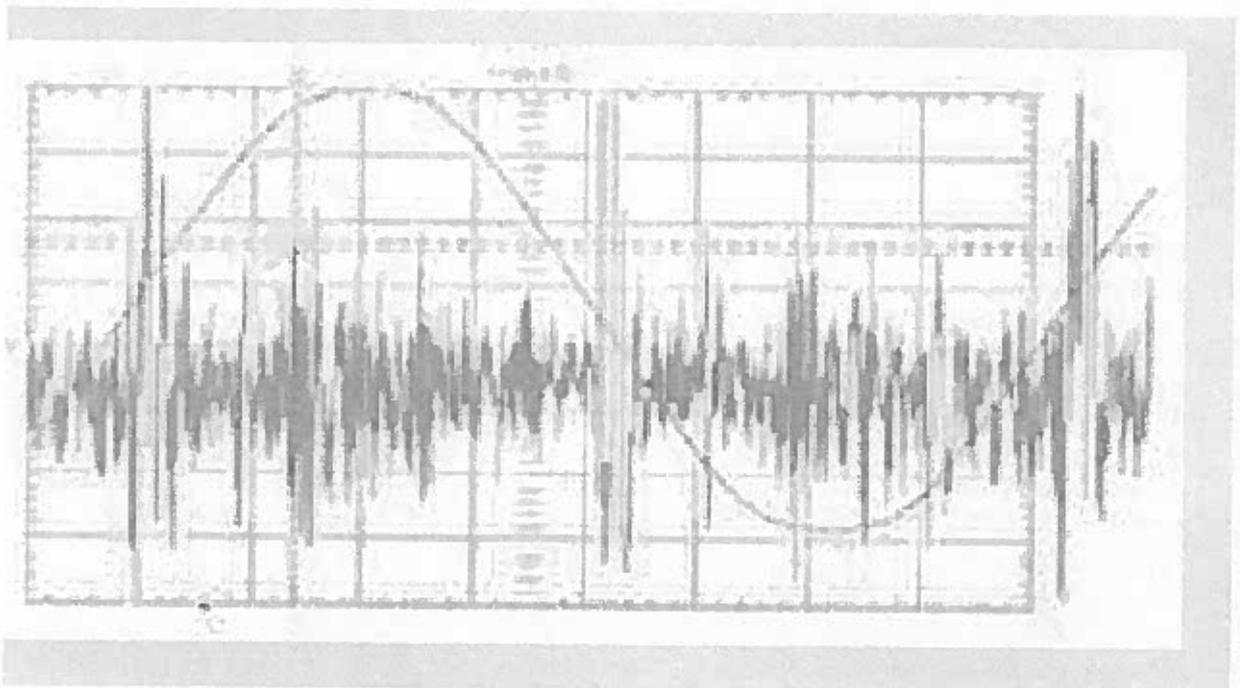
In my past responsibility in Electrical and Electronic designs this DTE/CeCO meter would not be acceptable for deployment. This series of interfering voltages creates what is commonly called "Dirty Electricity". The interference displayed also indicates that there is an out of control interference because the oscilloscope indicates there is no defined pattern to the interference. Besides the effects on health it also degrades the performance of home appliances leading to appliance damage such as furnaces, washers and dryers, refrigerators. These appliances have not been designed to operate in such an environment.

Once the RFI/EMI gets injected on to the home wires it become very expensive to mitigate the oscillations after it gets injected.

Noted epidemiologist Dr. Samuel Milham connects dirty electricity with heart disease, cancer, diabetes, and neurological disorders like ALS and suicide.

• <http://www.electricsense.com/5229/dirty-electricity-electrification-and-the-diseases-of-civilization/>

This waveform displayed is the same as an oscilloscope trace would look like, you cannot see this on a common voltmeter. Now we have introduced the effects of EMI/RFI to the same wire carrying the house current. This effect can be better depending on the environment especially how good the house earth ground is magnetically coupling the house voltage currents. There are many variables that affect this waveform. The smooth curve light blue is the standard 60 Hz line voltage. The red signal is the RFI/EMI. This is common on every meter I have tested.



Respectfully submitted,

*William S. Bathgate*

William S. Bathgate

## The Biological Effects of Weak Electromagnetic Fields

### Problems and solutions

*Andrew Goldsworthy March 2012*

#### Foreword

Dr Andrew Goldsworthy is a retired lecturer from Imperial College London, which is among the top three UK universities after Oxford and Cambridge and is renowned for its expertise in electrical engineering and health matters. Dr Goldsworthy spent many years studying calcium metabolism in living cells and also how cells, tissues and organisms are affected by electrical and electromagnetic fields. You may find much of what he says both surprising and worrying.

In this article, he explains how weak electromagnetic fields from cell phones, cordless phones and WiFi can have serious effects on our health. These include damage to glands resulting in obesity and related disorders, chronic fatigue, autism, increases in allergies and multiple chemical sensitivities, early dementia, DNA damage, loss of fertility and cancer.

All this happens at levels of radiation that our governments and the cell phone companies tell us are safe because the radiation is too weak to cause significant heating. **This is the only criterion that they use to assess safety.** In fact, the direct electrical effect on our cells, organs and tissues do far more damage to us at energy levels that may be hundreds or thousands of times lower than those that cause significant heating. These are termed non-thermal effects and **our governments are doing nothing to protect us from them.**

#### Abstract

*Many of the reported biological effects of non-ionising electromagnetic fields occur at levels too low to cause significant heating; i.e. they are non thermal. Most of them can be accounted for by electrical effects on living cells and their membranes. The alternating fields generate alternating electric currents that flow through cells and tissues and remove structurally-important calcium ions from cell membranes, which then makes them leak.*

*Electromagnetically treated water (as generated by electronic water conditioners used to remove lime scale from plumbing) has similar effects, implying that the effects of the fields can also be carried in the bloodstream. Virtually all of the non-thermal effects of electromagnetic radiation can be accounted for by the leakage of cell membranes.*

*Most of them involve the inward leakage of free calcium ions down an enormous electrochemical gradient to affect calcium-sensitive enzyme systems. This is the normal mechanism by which cells sense mechanical membrane damage. They normally respond by triggering mechanisms that stimulate growth and repair, including the MAP-kinase cascades, which amplify the signal.*

*If the damage is not too severe or prolonged, we see a stimulation of growth and the effect seems beneficial, but if the exposure is prolonged, these mechanisms are overcome and the result is ultimately harmful. This phenomenon occurs with both ionising and non-ionising radiation and is called radiation hormesis. Gland cells are a good example of this, since*

*short term exposures stimulate their activity but long term exposures cause visible damage and a loss of function. Damage to the thyroid gland from living within 100 metres of a cell phone base station caused hypothyroidism and may be partially responsible for our current outbreak of obesity and chronic fatigue.*

*Secondary effects of obesity include diabetes, gangrene, cardiac problems, renal failure and cancer. Cell phone base station radiation also affects the adrenal glands and stimulates the production of adrenalin and cortisol. Excess adrenalin causes headaches, cardiac arrhythmia, high blood pressure, tremors and an inability to sleep, all of which have been reported by people living close to base stations. The production of cortisol weakens the immune system and could make people living near base stations more susceptible to disease and cancer.*

*Inward calcium leakage in the neurons of the brain stimulates hyperactivity and makes it less able to concentrate on tasks, resulting in attention deficit hyperactivity disorder (ADHD). When this happens in the brains of unborn babies and young children, it reduces their ability to concentrate on learning social skills and can cause autism. Leakage of the cells of the peripheral nervous system in adults makes them send false signals to the brain, which results in the symptoms of electromagnetic intolerance (aka electromagnetic hypersensitivity). Some forms of electromagnetic intolerance may be due to cell phone damage to the parathyroid gland, which controls the calcium level in the blood and makes cell membranes more inclined to leak. Further exposure could then tip them over the edge into full symptoms of electromagnetic intolerance.*

*Cell phone radiation damages DNA indirectly, either by the leakage of digestive enzymes from lysosomes or the production of reactive oxygen species (ROS) from damaged mitochondrial and plasma membranes. The results are similar to those from exposure to gamma rays from a radioactive isotope.*

*Effects of DNA damage include an increased risk of cancer and a loss of fertility, both of which have been found in epidemiological studies. The effects of cell phone and WiFi radiation have also been determined experimentally using ejaculated semen. The results showed the production of ROS, and a loss of sperm quality and, in some cases, DNA fragmentation.*

*The inward leakage of calcium ions from electromagnetic fields also opens the various tight junction barriers in our bodies that normally protect us from allergens and toxins in the environment and prevent toxic materials in the bloodstream from entering sensitive parts of the body such as the brain. The opening of the blood-brain barrier has been shown to cause the death of neurons and can be expected to result in early dementia and Alzheimer's disease. The opening of the barrier in our respiratory epithelia by electromagnetic fields has been shown to increase the risk of asthma in children and the opening of the blood-liver barrier may be partially responsible for the current outbreak of liver disease. The opening of other barriers, such as the gut barrier allows foreign materials from the gut to enter the bloodstream, which may also promote allergies and has been linked autoimmune diseases.*

*Cell membranes also act as electrical insulators for the natural DC electric currents that they use to transmit power. Mitochondrial membranes use the flow of hydrogen ions to couple the oxidation of food to the production of ATP. The outer cell membrane uses the flow of sodium ions to couple the ATP produced to the uptake of nutrients. If either of these leak, or are permanently damaged, both of these processes will be compromised leading to a loss of available energy, which some people believe to be a contributory factor to chronic fatigue syndrome.*

*The mechanism underlying electromagnetically-induced membrane leakage is that weak ELF currents flowing through tissues preferentially remove structurally important calcium ions, but they have been shown to do so only within certain amplitude windows, above and below which there is little or no effect. This means that there is no simple dose-response curve, which many people find confusing, but a plausible theoretical model is described. The mechanism also explains why certain frequencies especially 16Hz is particularly effective.*

*Living cells have evolved defence mechanisms against non-ionising radiation. These include pumping out surplus calcium that has leaked into the cytosol, the closure of gap junctions to isolate the damaged cell, the production of ornithine decarboxylase to stabilize DNA and the production of heat-shock proteins, which act as chaperones to protect important enzymes. However, this is expensive in energy and resources and leads to a loss of cellular efficiency. If the exposure to the radiation is prolonged or frequently repeated, any stimulation of growth caused by the initial ingress of calcium runs out of resources and growth and repair becomes inhibited. If the repairs fail, the cell may die or become permanently damaged.*

*To some degree, we can make our own electromagnetic environment safer by avoiding ELF electrical and magnetic fields and radio waves that have been pulsed or amplitude modulated at ELF frequencies. The ELF frequencies that give damaging biological effects, as measured by calcium release from brain slices and ornithine decarboxylase production in tissue cultures, lie between 6Hz and 600Hz. It is unfortunate that virtually all digital mobile telecommunications systems use pulses within this range. The Industry clearly did not do its homework before letting these technologies loose on the general public and this omission may already have cost many lives.*

*Even now, it may be possible reverse their effects by burying the pulses in random magnetic noise, as proposed by Litovitz in the 1990s or by cancelling out the pulses using balanced signal technology but, at present, the Industry does not seem to be interested in either of these.*

*Until the mobile telecommunications industry makes its products more biologically friendly, we have little alternative but to reduce our personal exposure as far as possible by using cell phones only in emergencies, avoiding DECT cordless phones and substituting WiFi with Ethernet. The only DECT phones that are even remotely acceptable are those that automatically switch off the base station between calls; e.g. the Siemens Gigaset C595 operating in Eco Plus mode. If you are highly electromagnetically intolerant, you may need to screen your home or at the very least your bed from incoming microwave radiation and sleep as far away as possible from known sources of ELF.*

## **INTRODUCTION**

There have been many instances of harmful effects of electromagnetic fields from cell phones (aka mobile phones), DECT phones (aka cordless phones), WiFi, power lines and domestic wiring. They include an increased risk of cancer, loss of fertility, effects on the brain and symptoms of electromagnetic intolerance. Many people still believe that, because the energy of the fields is too low to give significant heating, they cannot have any biological effect. However, the evidence that alternating electromagnetic fields can have non-thermal biological effects is now overwhelming. See [www.bioinitiative.org](http://www.bioinitiative.org) and [www.neilcherry.com](http://www.neilcherry.com). The explanation is that it is not a heating effect, but mainly an electrical effect on the fine structure of the electrically-charged cell membranes upon which all living cells depend.

Alternating electromagnetic fields can induce *alternating currents* to flow through living cells and tissues. These can interfere with the normal *direct currents* and voltages that are essential for the metabolism of all cells. Virtually every living cell is a seething mass of electric currents and electrical and biochemical amplifiers that are essential for their normal

function. Some have tremendous amplifying capacity; e.g. it is claimed that a dark adapted human eye can detect a single photon (the smallest possible unit of light) and the human ear can hear sounds with energies as low as a billionth of a watt. We should therefore not be too surprised to find that our cells can detect and respond to electromagnetic fields that are orders of magnitude below the strength needed to generate significant heat.

My main objective here is to show how most of the adverse health effects of electromagnetic fields can be attributed to a single cause; that being that they remove structurally-important calcium ions (electrically-charged calcium atoms) from cell membranes, which then makes these membranes leak. I will explain the scientific evidence leading to this conclusion and also how we can put matters right, but still keep on using cell phones and other wireless communications. I have included key references that should enable the more inquisitive reader to delve deeper. In many cases, you should be able to find the abstract of the paper in question by copying into Google its entry in the list of references.

### **Electromagnetic fields affect many but not all people**

Many of the experiments on the biological effects of alternating electromagnetic fields appear to give inconsistent results. There are many reasons for this, including differences in the genetic make-up, physiological condition and the history of the test material. In humans, reported effects include an increased risk of cancer, effects on brain function, loss of fertility, metabolic changes, fatigue, disruption of the immune system, and various symptoms of electromagnetic intolerance.

Not everyone is affected in the same way and some may not be affected at all. However, there is increasing evidence that the situation is getting worse. Our electromagnetic exposure is rapidly increasing and previously healthy people are now becoming sensitised to it. In this study, I am concentrating on the cases where there have been definite effects; since this is the most efficient way in which we can find out what is going wrong and what can be done to prevent it.

### **The frequency of the fields is important**

The fields that give the most trouble are in the extremely low frequency range (ELF) and also radio frequencies that are pulsed or amplitude modulated by ELF. (Amplitude modulation is where the strength of a *carrier wave* transmits information by rising and falling in time with a lower frequency that carries the information.)

### **Why microwaves are particularly damaging**

The frequency of the carrier wave is also important. Higher frequencies such as the microwaves used in cell phones, WiFi and DECT phones, are the most damaging. Our present exposure to man-made microwaves is about a million billion billion (one followed by eighteen zeros) times greater than our natural exposure to these frequencies. We did not evolve in this environment and we should not be too surprised to find that at least some people may not be genetically adapted to it. As with most populations faced with an environmental change, those members that are not adapted either become ill, die prematurely or fail to reproduce adequately. Ironically, those who are electromagnetically intolerant may be better equipped to survive since they are driven to do whatever they can to avoid the radiation.

The main reason why microwaves are especially damaging is probably because of the ease with which the currents that they generate penetrate cell membranes. Cell membranes have a very high resistance to direct currents but, because they are so thin

(about 10nm), they behave like capacitors so that alternating currents pass through them easily. Since the effective resistance of a capacitor to alternating current (its *reactance*) is inversely proportional to its frequency, microwave currents pass through the membranes of cells and tissues more easily than radio waves of lower frequencies and can therefore do more damage to the cell contents.

### **Calcium loss from cell membranes explains most of the adverse health effects**

I became interested in this topic when I was working on the biological effects of physically (magnetically) conditioned water, which is widely used to remove lime scale from boilers and plumbing. It is made by allowing tap water to flow rapidly between the poles of a powerful magnet or by exposing it to a weak pulsed electromagnetic field from an electronic water conditioner. Water treated in this way can remove calcium ions (electrically charged calcium atoms) from surfaces, and the effect on the water can last for several days. I was following up some Russian and Israeli work that had shown that magnetically conditioned water could increase the growth of crops, but it turned out to be far more important than that. The underlying principle was also to explain the mechanisms by which weak electromagnetic fields can damage living cells and also what can be done to stop it.

### **Magnetically conditioned water and electromagnetic fields have similar effects**

Probably, our most important discovery was that when tap water was conditioned by weak electromagnetic fields, the treated water gave similar effects in yeast to those from exposing the yeast itself, amongst which was an increased permeability of their cell membranes to poisons (Goldsworthy *et al.* 1999). Since it had been known since the work of Bawin *et al.* (1975) that weak electromagnetic fields could remove calcium ions from the surfaces of brain cells, it seemed likely that both the conditioned water and the electromagnetic fields were working in the same way; i.e. **by removing structurally-important calcium ions from cell membranes, which then made them leak**. We now know that membrane leakage of this kind can explain most of the biological effects of both conditioned water and of direct exposure to electromagnetic fields.

### **The effects on growth depend on the length of the conditioning treatment**

We also showed that the effects of conditioned water on the growth of yeast cultures depended on the length of the conditioning process. Less than 30 seconds of conditioning stimulated growth but more than this inhibited growth. It was as if the conditioning process was steadily generating one or more chemical agents in the water. A low dose from the shorter conditioning period stimulated growth, but longer conditioning periods gave higher doses, which were inhibitory. This toxic effect of heavily conditioned water, where the water is recycled continuously through the conditioner, has now been exploited commercially to poison blanket weed in ornamental ponds

([www.lifescience.co.uk/domestic\\_blanketweed.htm](http://www.lifescience.co.uk/domestic_blanketweed.htm)). By the same token, blood continually circulating for prolonged periods under the pulsating fields from a cell phone or similar device could become toxic to the rest of the body. This means that no part of the body, from the brain to the liver and gonads, can be considered to be safe from the toxic effects of pulsed electromagnetic fields.

### **Radiation hormesis**

Many people have shown similar dual effects with direct exposure to both *ionising and non-ionising radiation*. Small doses of otherwise harmful radiation often stimulate growth and appear to be beneficial (a phenomenon known as *radiation hormesis*) but larger doses are harmful. It also explains why small doses of pulsed magnetic fields are effective in

treating some medical conditions such as broken bones (Bassett *et al.* 1974) but prolonged exposure (as we will see later) is harmful.

It also explains some of the apparent inconsistencies found when comparing different experiments and why meta-analysis of the data should be treated with caution. Clear positive and clear negative results (depending on the dose and the condition of the material) when taken together could be mistaken for no effect, but with a high degree of variability.

### **Cells have tremendous powers to amplify and respond to weak signals**

We now know that electromagnetic growth stimulation is almost certainly due to electrochemical amplification followed by the activation of the MAP kinase cascades by free calcium ions leaking into the cytosol (the main part of the cell). The inward leakage of calcium ions is the normal mechanism by which a cell senses that it has been damaged and triggers the necessary repair mechanisms. This involves huge amplification processes so that even minor leakage (e.g. due to membrane perforation or weak electromagnetic fields) can give rapid and often massive responses.

The first stage in the amplification is due to the calcium gradient itself. There is an enormous (over a thousand fold) concentration difference for free calcium between the inside and outside of living cells. In addition, there is a voltage difference of many tens of mV acting in the same direction. This means that even a slight change in the leakiness of the cell membrane can permit a very large inflow of calcium ions. It's like a transistor, where a slight change in the charge in the base can allow a massive current to flow through it under the influence of a high voltage gradient between the emitter and collector.

The next stage in the amplification is due to the extremely low calcium concentration in the cytosol so that even a small ingress of calcium ions makes a big *percentage* difference, to which many enzymes within the cell are sensitive.

Even more amplification comes from the MAP-kinase cascades. These are biochemical amplifiers that enable tiny amounts of growth factors or hormones (perhaps even a single molecule) to give very large effects. They consist of chains of enzymes acting in sequence so that the first enzyme activates many molecules of the second enzyme, which in turn activates still more of the third enzyme etc. The final stage then activates the protein synthesising machinery needed for cell growth and repair.

At least some of these cascades need calcium ions to work (Cho *et al.* 1992) so the inward leakage of calcium through damaged cell membranes will increase the rate of these processes to stimulate growth and repair. However, these repairs can make deep inroads into the cell's energy and resources, and its ability to make good the damage will depend on its physiological and nutritional condition. This means that, if the damage is prolonged or persistent, sooner or later it runs out of resources and gives up, which is when we see the inhibitory phase, perhaps followed by apoptosis (cell death) or the loss of some of the cell's normal functions. We are now seeing this loss of function increasingly after prolonged human exposure to cell phone base station radiation; e.g. the loss of thyroid gland function after six years of exposure (Eskander *et al.* 2012).

### **Effects on Glands**

#### **Gland cells are particularly sensitive to radiation**

Gland cells may be particularly sensitive to radiation because their secretions are normally produced in internal membrane systems, which can also be damaged. Their secretions are usually released in vesicles (bubbles of membrane) that fuse with the external

cell membrane and discharge their contents to the outside (exocytosis). The vesicle membrane then becomes part of the external membrane. The resulting excess external membrane is counterbalanced by the reverse process (endocytosis) in which the external membrane buds off vesicles to the inside of the cell, which then fuse with the internal membranes. In this way, an active gland cell may internalise the equivalent of its entire surface membrane about once every half an hour. This means that if the surface membrane is damaged directly by the fields, or by electromagnetically conditioned blood, the damaged membrane rapidly becomes part of the internal membrane system, upon which its normal activity depends. If the damage is too severe, the whole gland may lose its normal function.

### Electromagnetic effects on the endocrine system and obesity

Although electromagnetic fields frequently stimulate glandular activity in the short term, long term exposure is often harmful in that the gland ceases to work properly. This is particularly serious for the glands of the endocrine system (those that coordinate our bodily functions) since it can affect many aspects of metabolism and throw the whole body out of kilter. For example it may be responsible, at least in part, for the current outbreak of obesity and the many other illnesses that stem from it.

An good example of this is the thyroid gland, which is in an exposed position in the front of the neck. Rajkovic *et al.* (2003) showed that after three months exposure to power line frequencies, the thyroid glands of rats showed visible signs of deterioration. They also lost their ability to produce the thyroid hormones, which they did not recover even after the fields were switched off. Esmekaya *et al.* (2010) found a similar visible deterioration of the thyroid gland in rats exposed to simulated 2G cell phone radiation for 20 minutes a day for three weeks. Eskander *et al.* (2012) found that people living for six years within 100 metres of a cell phone base station showed a significant reduction in the release into the blood of a number of hormones, including ACTH from the pituitary gland, cortisol from the adrenal glands, and prolactin and testosterone from organs elsewhere. However, the most highly significant loss was in their ability to produce the thyroid hormones. The expected consequence of this is hypothyroidism, the most frequent symptoms of which are **fatigue** and **obesity**. It may not be a coincidence that about a quarter of a million UK citizens are now suffering from what is being diagnosed as chronic fatigue syndrome, and about eight out of ten are either overweight or clinically obese.

The incidence of obesity may be exacerbated by effects on the release of the appetite regulating hormones ghrelin and peptide YY. Ghrelin is synthesised in the stomach wall and makes us feel hungry, whereas peptide YY is made in the intestine wall and makes us feel full. In normal people the level of ghrelin in the blood is high before a meal and goes down afterwards whereas peptide YY goes up, so we go from feeling hungry to feeling full, which stops us overeating.

However, in obese people the level of both hormones stays roughly the same throughout so that they never feel completely full and eat in an unregulated manner (Le Roux *et al.* 2005, Le Roux *et al.* 2006). If prolonged exposure to electromagnetic fields limits the release of these hormones in the same way as they affect the release of ACTH, cortisol, prolactin, testosterone and the thyroid hormones, it may explain why so many people find it difficult to stop eating and end up being clinically obese.

If you are affected in this way, you may be forced to go on a life-long diet, undergo gastric bypass surgery to drastically reduce the size of your stomach or risk the many serious diseases that stem from obesity **AND IT MAY NOT HAVE BEEN YOUR FAULT**. Think twice before you use a cell phone or install a cordless phone or WiFi. The consequences are only now becoming apparent; neither the Government nor the telecommunications industry will tell you what they are, but they are not good.

### Obesity can trigger many other illnesses

The consequences of obesity include **diabetes, gangrene, high blood pressure, cardiac problems, renal failure and cancer**. Between them, they cause a great deal of human suffering and cost the nation's economy a great deal of money. The annual cost of obesity and related illnesses to the UK economy has been estimated as being around £6.6 – 7.4 billion (McCormick *et al.* 2007).

The annual cost of chronic fatigue syndrome is about \$20000 per affected person in the USA (Reynolds *et al.* <http://www.resource-allocation.com/content/2/1/4> ) and about £14000 in the UK (McCrone *et al.* 2003) so a fair estimate of the total annual cost of chronic fatigue syndrome to the UK economy would be somewhere in the region £3.5 billion. The total annual cost of both conditions together is about £10 billion. If part of this is due to microwave telecommunications, measures need to be taken to minimise their effects, and it would be only fair to ask the Industry to pay for this.

### Electromagnetic effects on the adrenal gland

**Cortisol:** - Augner *et al.* (2010) in a double blind study (where neither the subject nor the person recording the results knows whether the radiation is switched on or off) showed that short-term exposure to the radiation from a 2G (GSM) cell phone base station increased the cortisol level in the saliva of human volunteers. Cortisol is a stress hormone that is normally produced in the cortex of the adrenal glands and is controlled by the calcium level in its cells (Davies *et al.* 1985) so electromagnetically- induced membrane leakage letting more calcium into the cytosol should also have this effect.

Cortisol is part of a mechanism that puts the body into a "fight or flight" mode, in which more sugar is released into the blood, sensitivity to pain is reduced and the immune system is suppressed. In fact, cortisol and its relatives are used medicinally to relieve pain and also to suppress the immune system after transplant surgery. However, when exposure to base station radiation does it, it is not good news since the suppression of the immune system will also increase the risk of infection and of developing tumours from precancerous cells that might otherwise have been destroyed.

**Adrenalin:** - Buchner and Eger (2011) studied the effect of a newly installed 2G cell phone base station on villagers in Bavaria and found that it caused a long-lived increase in the production of adrenalin. This is an important neurotransmitter which acts on adrenergic receptors to increase the calcium concentration in the cytosol. It is also synthesised in the adrenal medulla in response to signals from the sympathetic nervous system. Adrenalin too puts the body into fight or flight mode by diverting resources from the smooth muscles of the gut to the heart muscle and the skeletal muscles needed for flight or combat. In addition, it stimulates the production of cortisol by the adrenal cortex, and indirectly reduces the activity of the immune system, resistance to disease and increases the risk of getting cancer.

Some people get pleasure from the "adrenalin rush" caused by doing energetic or dangerous things, and this could be a contributory factor to the addictive nature of cell phones. However, on the down side, known effects of excess adrenalin include, headaches, cardiac arrhythmia, high blood pressure, tremors, anxiety and inability to sleep. These results confirm and explain some of the findings of Abdel-Rassoul *et al.* (2007) who found that people living near cell towers (masts) had significantly increases in headaches, memory loss, dizziness, tremors and poor sleep.

## Effects on the Brain

### Calcium leakage and brain function

Normal brain function depends on the orderly transmission of signals through a mass of about 100 billion *neurons*. Neurons are typically highly branched nerve cells. They usually have one long branch (*the axon*), which carries electrical signals as *action potentials* (nerve impulses) to or from other parts of the body or between relatively distant parts of the brain (a nerve contains many axons bundled together). The shorter branches communicate with other neurons where their ends are adjacent at *synapses*. They transmit information across the synapses using a range of *neurotransmitters*, which are chemicals secreted by one neuron and detected by the other.

Calcium ions play an essential role in brain function because a small amount of calcium must enter the cytosol of the neuron before it can release its neurotransmitters (Alberts *et al.* 2002). Electromagnetically-induced membrane leakage would increase the background level of calcium in the neurons so that they release their neurotransmitters sooner. This improves our reaction time to simple stimuli but it can also trigger the spontaneous release of neurotransmitters to send spurious signals that have no right to be there, which makes the brain hyperactive and less able to concentrate.

### Autism

Possibly, the greatest damage to the brain from microwaves is when it is first developing in the foetus and the very young child, where it can lead to autism. Dr Dietrich Klinghardt has shown a relationship between microwaves and autism; a summary of his work can be found at <http://electromagnetichealth.org/media-stories/#Autism> .

### What is autism?

Autism is a group of life-long disorders (autistic spectrum disorders or ASD) caused by brain malfunctions and is associated with subtle changes in brain anatomy (see Amaral *et al.* 2008 for a review). The core symptoms are an inability to communicate adequately with others and include abnormal social behaviour, poor verbal and non-verbal communication, unusual and restricted interests, and persistent repetitive behaviour. There are also non-core symptoms, such as an increased risk of epileptic seizures, anxiety and mood disorders. ASD has a strong genetic component, occurs predominantly in males and tends to run in families.

### Genetic ASD may be caused by calcium entering neurons

It has been hypothesised that some genetic forms of ASD can be accounted for by known mutations in the genes for ion channels that result in an increased background concentration of calcium in neurons. This would be expected to lead to neuronal hyperactivity and the formation of sometimes unnecessary and inappropriate synapses, which in turn can lead to ASD (Krey and Dolmetsch 2007).

### Electromagnetic fields also let calcium into neurons

There has been a 60-fold increase in ASD in recent years, which cannot be accounted for by improvements in diagnostic methods and can only be explained by changes in the environment. This increase corresponds in time to the proliferation of mobile telecommunications, WiFi, and microwave ovens as well as extremely low frequency fields from household wiring and domestic appliances. We can now explain at least some of this in

terms of electromagnetically-induced membrane leakage leading to brain hyperactivity and abnormal brain development.

### **How membrane leakage affects neurons**

Neurons transmit information between one another in as chemical neurotransmitters that pass across the synapses where they make contact. Their release is normally triggered by a brief pulse of calcium entering their cytosols. If the membrane is leaky due to electromagnetic exposure, it will already have a high internal calcium concentration as calcium leaks in from the much higher concentration outside. This puts the cells into hair-trigger mode so that they are more likely to release neurotransmitters and the brain as a whole may become hyperactive (Beason and Semm 2002; Krey and Dolmetsch 2007, Volkow *et al.* 2011). This results in the brain becoming overloaded with sometimes spurious signals leading to a loss of concentration and attention deficit hyperactive disorder (ADHD).

### **How does this impact on autism?**

Before and just after its birth, a child's brain is a blank canvas, and it goes through an intense period of learning to become aware of the significance of its new sensory inputs, e.g. to recognise its mother's face, her expressions and eventually other people and their relationship to him/her (Hawley and Gunner 2000). During this process, the neurons in the brain make countless new connections, the patterns of which store what the child has learnt. However, after a matter of months, connections that are rarely used are pruned automatically (Huttenlocher and Dabholkar 1997) so that those that remain are hard-wired into the child's psyche. The production of too many spurious signals due to electromagnetic exposure during this period will generate frequent random connections, which will also not be pruned, even though they may not make sense. It may be significant that autistic children tend to have slightly larger heads, possibly to accommodate unpruned neurons (Hill and Frith 2003).

Because the pruning process in electromagnetically-exposed children may be more random, it could leave the child with a defective hard-wired mind-set for social interactions, which may then contribute to the various autistic spectrum disorders. These children are not necessarily unintelligent; they may even have more brain cells than the rest of us and some may actually be savants. They may just be held back from having a normal life by a deficiency in the dedicated hard-wired neural networks needed for efficient communication.

### **Autism costs the UK economy more than the tax income from cell phones**

The incidence of autism has occurred in parallel with the increase in electromagnetic pollution over the last thirty years. The chance of having an autistic child may now be as high as one in fifty. Apart from the personal tragedies for the affected children and their families, autism is of enormous economic importance. In the UK alone, the annual cost to the Nation in care and lost production exceeds the annual tax revenue from the entire cell phone industry, which is about 20billion UK pounds.

<http://www2.lse.ac.uk/newsAndMedia/news/archives/2009/05/MartinKnappAutism.aspx> If it were all due to cell phones, the Government could close down the entire industry and actually show a profit! There may be ways in which the modulation of the signal can be changed to avoid this (see later), but in the meantime, we should do whatever we can to minimise our exposure to information-carrying microwaves, including those from cell phones, DECT phones, WiFi and smart meters. Failure to do this could be very costly.

### **Electromagnetic intolerance (aka electromagnetic hypersensitivity or EHS)**

Electromagnetic intolerance is a condition in which some people experience a wide range of unpleasant symptoms when exposed to weak non-ionising radiation. About 3 percent of the population suffers in this way at present, although only a small proportion of these are as yet so badly affected that they can instantly tell whether a radiating device is switched on or off. At the other end of the scale, there are people who are sensitive but do not yet know it because they are chronically exposed to electromagnetic fields and accept their symptoms as being perfectly normal. Electromagnetic intolerance is in fact a continuum with no clear cut-off point. In some cases there may only be relatively mild symptoms on or after using a cell phone but in severe cases it can prevent people living a normal life and force them to live in almost total isolation. There is every reason to believe that prolonged exposure will increase the severity of the symptoms, so if you suffer from any of them you should do whatever possible to minimise further exposure.

### **Symptoms of electromagnetic intolerance**

Symptoms include skin rashes, cardiac arrhythmia, headaches (sometimes severe), pain in muscles and joints, sensations of heat or cold, pins and needles, tinnitus, dizziness and nausea. A more complete list can be found at <http://www.es-uk.info/info/recognising.asp>. Most if not all of these can be explained by the radiation making cells leak.

**When skin cells leak**, it is perceived by the body as damage to the tissue. This increases the blood supply to the area to repair the damage and causes the rash.

**When the cells of the heart muscle leak** it weakens the electrical signals that normally control its contraction. The heart then runs out of control to give cardiac arrhythmia. This is potentially life threatening.

**When sensory cells leak**, they become hyperactive and send false signals to the brain. We have a variety of sensory cells, but they all work in much the same way. Whenever they sense what they are supposed to sense, they deliberately leak by opening ion channels in their membranes. This reduces the natural voltage across these membranes, which makes them send nerve impulses to the brain. Electromagnetically induced cell leakage would have the same effect, but this time it would make them send *false* signals to the brain to give the false sensations of electromagnetic intolerance. This could also be exacerbated by the nerve cells involved being made hyperactive due to calcium ingress.

**When leakage occurs in the sensory cells of the skin**, it can give sensations such as heat, cold, tingling, pressure etc, depending on which types of cell are most sensitive in the individual concerned.

**When leakage occurs in the sensory hair cells of the cochlea of ear** it gives tinnitus, which is a false sensation of sound. When it occurs in the vestibular system (the part of the inner ear that deals with balance and motion) it results in dizziness and symptoms of motion sickness, including nausea.

### **Hypocalcaemia, electromagnetic intolerance and the parathyroid gland**

Symptoms of hypocalcaemia are very similar to those of electromagnetic intolerance and include skin disorders, pins and needles, numbness, sensations of burning, fatigue, muscle cramps, cardiac arrhythmia, gastro-intestinal problems and many others. A more comprehensive list can be found at <http://www.endotext.org/parathyroid/parathyroid7/parathyroid7.htm> . It is possible that some

forms of electromagnetic intolerance are due to low levels of calcium in the blood. Electromagnetic exposure would then remove even more calcium from their cell membranes to push them over the edge and give the symptoms of electromagnetic intolerance.

The amount of calcium in the blood is controlled by the parathyroid hormone secreted by the parathyroid gland, which is in the neck, close to where you hold your cell phone. It is adjacent to the thyroid gland and, if it were to be damaged by the radiation in the same way, the production of the parathyroid hormone would go down, the amount of calcium in the blood would be reduced and the person concerned would become electromagnetically intolerant.

## **Effects on DNA**

### **Cell phone radiation can damage DNA**

Lai and Singh (1995) were the first to show this in cultured rat brain cells, but it has since been confirmed by many other workers. A comprehensive study on this was in the Reflex Project, sponsored by the European Commission and replicated in laboratories in several European countries. They found that radiation like that from GSM (2G) cell phone handsets caused both single and double stranded breaks in the DNA of cultured human and animal cells. Not all cell types were equally affected and some, such as lymphocytes, seemed not to be affected at all (Reflex Report 2004).

In susceptible cells, the degree of damage depended on the duration of the exposure. With human fibroblasts, it reached a maximum at around 16 hours (Diem *et al.* 2005). However, it would be unwise to assume that exposures of less than 16 hours are necessarily safe since DNA damage may give genetically aberrant cells long before it becomes obvious under the microscope. It would also be unwise to assume that the damage would be restricted to the immediate vicinity of the handset since, as described earlier, the effects of the radiation can be transmitted in the bloodstream in the form of magnetically conditioned blood; so nowhere is safe, not even the sex organs.

### **How the DNA is damaged**

Because of the very high stability of DNA molecules, they are unlikely to be damaged directly by weak radiation. The most plausible mechanism is that DNase (an enzyme that destroys DNA) and other digestive enzymes leak through the membranes of lysosomes (organelles that digest waste) that have been damaged by the radiation. Other mechanisms involve the leakage of reactive oxygen species (ROS) such as hydrogen peroxide from damaged peroxisomes and superoxide free radicals from damaged mitochondrial membranes and NADH oxidase in the plasma membrane. According to Friedman *et al.* (2007), the first to respond to non-thermal cell phone frequencies is the NADH oxidase in the plasma membrane, which is activated within minutes of exposure.

However, all of these ROS can initiate peroxidation chain reactions in the polyunsaturated phospholipids of cell membranes (the same thing that makes fats go rancid) which disrupts the membranes further and exacerbates the effect. Only one molecule of ROS is needed to initiate a domino-effect chain reaction, in which each damaged lipid molecule generates a free radical that damages the next one. The process normally stops when it reaches an anti-oxidant molecule, which sacrifices itself by combining with the free radical in such a way that it does not generate a new one. Most of our anti-oxidants come from our diet (e.g. vitamin E) but the most important one that we make ourselves is *melatonin*. It's unfortunate that the production of melatonin by the pineal gland is also

disrupted by electromagnetic fields (Henshaw and Reiter, 2005) which makes matters worse.

These ROS are highly reactive and can also damage DNA. In fact, much of the damage done to cells by *ionising radiation* such as *gamma rays* is due to damage to cell membranes and DNA by free radicals from the radiolysis of water. There may therefore be little difference between holding a cell phone to your head and holding a radioactive source of gamma rays. Both can damage cell membranes, cause the fragmentation of DNA and also do considerable collateral damage to other cellular components, which may either kill the cells or make them lose their normal function over time.

### **Cell phones increase the risk of cancer**

If similar DNA fragmentation were to occur in the whole organism, we would expect an increased risk of cancer, since essential genes that control cell division may be either damaged or lost. Recent studies on the incidence of brain cancer are already beginning to show this. Heavy cell phone use roughly doubles the risk of getting brain cancers in adults on the side of the head used for the cell phone. For younger people, the risk increases to five times more (Hardell and Carlberg 2009). Since brain cancers normally take decades to develop, it is too soon to assess the final impact of the radiation, but the World Health Organisation has already classified cell phones as a Group 2B Carcinogen (possibly carcinogenic) similar to benzene and DDT. Other head cancers are also on the increase, including cancers of the parotid salivary gland (next to where you hold your cell phone) and the thyroid gland, which is in the neck.

### **Cell phones reduce male fertility**

We might expect DNA damage in the cells of the germ-line (the line of cells starting in the embryo that eventually gives rise to eggs and sperm) to result in a loss of fertility. A number of epidemiological studies have shown significant reductions in sperm motility, viability and quantity in men using cell phones for more than a few hours a day (Fejes *et al.* 2005; Agarwal *et al.* 2006) and the subject was reviewed by Desai *et al.* (2009). A common finding is that these effects were associated with the production of reactive oxygen species (ROS) which can damage many cellular components, including cell membranes and DNA.

More recently, Agarwal *et al.* (2009) found in controlled experiments that ejaculated sperm from healthy donors showed reduced viability and motility and an increase in ROS after one hour's exposure to a cell phone in talk mode. More recently still, Avandano *et al.* 2012 found that exposing ejaculated semen to a WiFi laptop for four hours gave a decrease in sperm motility and an increase in DNA fragmentation as compared with samples exposed to a similar computer with the WiFi switched off.

A similar relationship between sperm quality and electromagnetic exposure has also been found for low frequency alternating magnetic fields (Li *et al.* 2010). It is therefore advisable for men to avoid strong magnetic fields, restrict their cell phone calls to a minimum and keep them switched off (or in airplane mode if it has this facility). Otherwise, the phones transmit regularly at full power to the base station, even when not in use. If they have to be switched on for any reason, men should at least keep them out of their trouser pockets.

### **Possible effects on female fertility**

We do not yet know the effects of cell phone use on human female fertility, but . Panagopoulos *et al.* (2007) showed that exposing adult *Drosophila melanogaster* (an insect

widely used in genetic experiments) to a GSM phone signal for just six minutes a day for six days fragmented the DNA in the cells that give rise to their eggs and half of these eggs died. We humans should therefore exercise caution since, although our sperm are produced in their countless billions and take about three months to mature, all the eggs that a woman will ever have were in her ovaries before she was born and will be exposed to the radiation (and electromagnetically conditioned blood) throughout her life. There could therefore be considerable cumulative damage, both to the eggs and the follicle cells that nourish and protect them. Damage to either, beginning when the child is in the womb, can be expected to cause a loss of fertility. Pregnant mothers should avoid all present forms of microwave telecommunications, including cell phones and WiFi. Her child could be damaged by their radiation, but she will not know until she reaches puberty and wants a child herself.

### **Effects on tight junction barriers**

Tight junction barriers are layers of cells where the gaps between them are sealed by *tight-junctions* to prevent materials leaking around their sides. They protect all of our body surfaces from the entry of unwanted materials and often protect one part of the body from being unduly influenced by the others. For example, the blood-brain barrier prevents toxins entering the brain from the bloodstream. Normally, these barriers are closed but they are programmed to open if calcium ions enter their cells. This was demonstrated by Kan and Coleman (1988) who showed that the calcium ionophore A23187 (an antibiotic that kills bacteria and fungi by letting calcium ions leak into their cells) opened tight junction barriers in the liver. The electromagnetic opening of the blood-liver barrier could be a contributory factor to the current outbreak of liver disease in the UK among the under forties (the cell phone generation), which is at present being blamed on alcohol abuse. Since all tight junction barriers have basically the same design, unscheduled calcium entry resulting from electromagnetic exposure is likely to open all of them in much the same way. The opening of our tight junction barriers by electromagnetic fields can account for many modern illnesses, ranging from asthma to multiple allergies and Alzheimer's disease.

### **The blood-brain barrier and early dementia**

The blood-brain barrier normally prevents possibly toxic large molecules from the bloodstream entering the brain. The radiation from cell phones, even at one hundredth of the permitted SAR value, can open the blood brain barrier in rats so that protein molecules as large as albumin could enter their brains (Persson *et al.* 1997). Later experiments by Salford *et al.* (2003) showed that this was associated with the death of neurons. We would not expect an immediate effect because the brain has spare capacity, but prolonged or repeated exposure to cell phone or similar radiation would be expected to cause a progressive loss of functional neurons and result in early dementia and Alzheimer's disease in humans. The extreme sensitivity of the blood-brain barrier to the radiation could mean that even sitting close to someone using a cell phone could affect you too. It may not be too surprising to find that early onset Alzheimer's disease is now on the increase in modern society.

### **The respiratory barrier and asthma**

Di *et al.* (2011) showed that exposure to weak ELF electromagnetic fields during pregnancy increased the risk of asthma in the offspring (they did not test microwaves). This can be explained by the radiation removing structural calcium from the cells of the tight junction barrier lining the respiratory tract, which then opens. This is supported by the findings of Chu *et al.* (2001) who showed that either low levels of external calcium or the addition of EGTA, both of which would remove structural calcium ions from cell surfaces, caused massive increases in its electrical conductance (a measure of its permeability to ions) and also to its permeability to much larger virus particles. We would therefore expect many allergens to enter by the same route and predispose the child to asthma. There are

about 5.4 million people with asthma in the UK and the estimated annual cost to the NHS alone is about £1 billion  
([http://www.asthma.org.uk/news\\_media/news/new\\_data\\_reveals\\_hiq.html](http://www.asthma.org.uk/news_media/news/new_data_reveals_hiq.html))

### **The skin barrier, allergies and multiple chemical sensitivities**

The skin tight junction barrier is in the *stratum granulosum*, which is the outermost layer of *living* skin cells just underneath the many layers of dead cells (Borgens *et al.* 1989). Furuse *et al.* (2002) showed that mutant mice deficient in Claudin-1 (a vital component of the sealing mechanism) died within a day of birth and their skin barriers were permeable to molecules as large as 600D, which is enough to admit many unwanted foreign materials, including potential allergens. In humans, this could be the basis of *multiple chemical sensitivities*, where people have become allergic to a wide range of chemicals, although they leave most of us unaffected. People suffering from multiple chemical sensitivities are often also electromagnetically intolerant and many of their symptoms are very similar.

Virtually all of our body surfaces are protected by cells with tight junctions, including the nasal mucosa (Hussar *et al.* 2002), the lungs (Weiss *et al.* 2003) and the lining of the gut (Arrieta *et al.* 2006). An electromagnetically-induced increase in the permeability of any of these would allow the more rapid entry into the body of a whole range of foreign materials, including allergens, toxins and carcinogens.

### **Loss of barrier tightness can trigger autoimmune diseases**

An electromagnetically-induced increase in the permeability of any of the tight-junction barriers has been linked to the occurrence of autoimmune diseases, in which lymphocytes the immune system attacks the body's own components as if they were foreign materials or pathogens.

The immune system is quite complicated but basically lymphocytes (a type of white blood cell) are trained and selected before they mature to recognise the body's own cells, which are normally present in the bloodstream, by virtue of chemical patterns on their surfaces (the major histocompatibility complexes).

B-lymphocytes make specific antibodies that combine with foreign cells and substances that do not have this pattern, which marks them for eventual ingestion and digestion by phagocytes (another type of white blood cell). T-lymphocytes kill the body's own cells if they are infected with a virus, which is normally displayed on the cell surface. In both cases, the presence of the foreign material or infected cells trigger the rapid multiplication of a clone of lymphocytes that recognise them. They can then attack it in force.

However, if the substance concerned belongs to the body itself but is normally prevented from entering the bloodstream by a tight-junction barrier such as the blood-brain barrier, when that barrier opens, it increases the likelihood of its leaking unfamiliar materials into the bloodstream and triggering an autoimmune response. For example, Grigoriev *et al.* (2010) showed that 30 days exposure to unmodulated 2450MHz microwave radiation triggered a small but significant increase in anti-brain antibodies in the blood of rats. In other words, the radiation had sensitised the body's immune system to one or more components of its own brain, which could then result in an autoimmune attack on the brain and/or nervous system. An example of an autoimmune disease of the brain is Graves disease in which the pituitary gland (at the base of the brain) is affected.

In addition, an increase in the permeability of the gut barrier has been linked to several other autoimmune diseases, including type-1 diabetes, Crohn's disease, celiac disease, multiple sclerosis and irritable bowel syndrome (Arrieta *et al.* 2006).

### **Cell membranes as current generators and electrical insulators**

***Cell membranes not only keep apart materials that must not be allowed to mix, they also act as electrical insulators for the natural electric currents upon which all of our cells depend.***

### **Natural electric currents are important in power and information transfer**

Almost every living cell is a seething mass of electric currents and amplifiers. For example, these currents are important in energy production in mitochondria (the cell's power stations) and in cell signalling (the transfer of information within and between cells). They are carried as flows of ions, which are the normal ways in which electricity is carried through water and through living cells.

### **These natural currents are generated by cell membranes.**

Natural electric currents are normally generated by molecular ion pumps in cell membranes. These are proteins that use metabolic energy to transport specific ions, usually one or two at a time, from one side of the membrane to the other. This generates a voltage across the membrane (*the membrane potential*) and a chemical imbalance between the concentrations of ions on either side. Their combined effect gives an *electrochemical gradient*, which provides energy for other functions.

### **Mitochondria use electrochemical gradients to transmit power**

Mitochondria are tiny structures, about the size of bacteria, inside almost all of our cells. They evolved when an aerobic bacterium, which used oxygen to metabolise its food, was engulfed by an anaerobic organism, which could not do this, but was more efficient in other respects. From then on they lived together symbiotically, but are still separate in that that the mitochondria are surrounded by two membranes; the inner one belonging to the bacterium and the outer one to its host.

The inner membrane does the electrical work by a process known as chemiosmosis. The inside of the mitochondrion contains enzymes that convert materials from our food into forms that can combine with oxygen. This combination with oxygen occurs using enzymes actually within the membrane, and the released energy is used to expel hydrogen ions to create an electrochemical gradient between the inside and the outside of the mitochondrion. They are then allowed back through another enzyme in the membrane called ATP synthase that uses the gradient to make ATP, which is the main energy currency of the cell. The cycle then repeats to give an electrical circuit with hydrogen ions carrying the electricity from where it is made to where it is used, with the membrane being the insulator (Alberts *et al.* 2002).

### **What happens if the mitochondrial membrane is damaged?**

Damage to the inner mitochondrial membrane can have two main effects. If it just leaked it would short circuit the system, reduce ATP synthesis and deprive the cell of energy. If the damage were also to include the oxidising enzymes, they could release free

radicals, which are normal intermediates in the process. This would damage both the inside of the mitochondrion (including its DNA) and also the rest of the cell. Mitochondrial dysfunction of this sort is thought to be a possible cause of chronic fatigue syndrome.

### **Other membranes also use ion currents to transfer energy**

Most other cell membranes use ion currents as a source of energy. For example, enzymes in the outer membrane of each cell (*the plasma membrane*) use energy from ATP to pump positively charged sodium ions out of the cell. This generates its own membrane potential, which typically makes the inside of the cell about 70-100mV negative to the outside. This provides energy for the active transport of other materials across the membrane against a concentration gradient. In this case, the sodium ions that have been expelled are allowed back in, through transporter enzymes, but they carry with them nutrients from the outside by a process called ion co-transport (Alberts *et al.* 2002) If this membrane leaks, it will short circuit the voltage across it and reduce nutrient uptake as well as a number of other processes which use this voltage as a source of energy.

### **Ion channels in cell membranes are used for cell signalling**

Ion channels are pores in cell membranes that can let large quantities of specific ions through very quickly, but only down their own electrochemical gradient. They normally open and close in response to specific stimuli; e.g. changes in voltage across the membrane or the presence of other chemicals. They can be thought of as amplifiers by which a tiny stimulus can cause a very large current to flow almost instantly to give a rapid biological effect. An example of this is the coordinated opening and closing of sodium and potassium channels that continuously amplify nerve impulses and enable them to travel from one end of the body to the other, both rapidly and without loss.

### **The mechanisms of cell membrane leakage.**

We have known since the work of Suzanne Bawin and her co-workers (Bawin *et al.* 1975) that electromagnetic radiation that is far too weak to cause significant heating can nevertheless remove radioactively labelled calcium ions from cell membranes. Later, Carl Blackman showed that this occurs only with weak radiation, and then only within one or more '*amplitude windows*', above and below which there is little or no effect (Blackman *et al.* 1982; Blackman 1990).

### **The apple harvester: an explanation for amplitude windows**

A simple way to explain the selective removal of divalent ions is to imagine trying to harvest ripe apples by shaking the tree. If you don't shake it hard enough, no apples fall off, but if you shake it too hard, they all fall off. However, if you get it just right, only the ripe ones fall off and are 'selectively harvested'.

We can apply the same logic to the positive ions bound to cell membranes. Alternating voltages try to drive these ions off and then back onto the membranes with each cycle. If the voltage is too low, nothing happens. If it is too high, all the ions fly off, but return when the voltage reverses. However, if it is just the right, it will tend to remove only the more strongly charged ones, such as divalent calcium with its double charge. If the frequency is low, at least some of these divalent ions will diffuse away and be replaced at random by other ions when the field reverses. There will then be a net removal of divalent ions with each successive cycle until enough have been removed to cause significant membrane leakage and give a biological effect, but only within a narrow range of field strength to give

an *amplitude window*. Pulses are more effective than smooth sine waves because their rapid rise and fall times catapult the ions quickly away from the membrane and leave more time for them to be replaced by different ions before the field reverses.

### **Frequency windows and resonance effects**

If a molecule or structure has a natural resonant frequency, it may respond selectively to that frequency. For example, if you keep giving a pendulum a gentle push at just the right time at the end of its travel, the energy of each push builds up and is stored in the ever increasing violence of its motion. If you were suddenly to stop it by putting your hand in the way, the combined energy of each push is released in one go and could do more damage to your hand than the energy you gave it from each individual push.

In the same way, if an electrically charged atom or molecule has one or more natural resonant frequencies and you give it an electromagnetic pulse at that frequency, it may store the combined energy of each pulse as some sort of vibration. This could enable it to bring about a chemical reaction that would not have been possible from the energy of each pulse alone, *but only at its resonant frequency*. Some frequencies are especially effective in giving biological effects. An example is 16Hz, which is the ion cyclotron resonance frequency of potassium ions in the Earth's magnetic field.

Ion cyclotron resonance occurs when ions move in a steady magnetic field such as that of the Earth. They are deflected sideways by the magnetic field and go into orbit around its lines of force at a frequency that depends on the charge to mass ratio of the ion and the strength of the steady field (see Liboff *et al.* 1990). If they are simultaneously exposed to an alternating field at this frequency, they absorb its energy and increase the diameter of their orbits, which increases their energy of motion and chemical activity. Potassium resonance is particularly important because potassium is the most abundant positive ion in the cytosols of living cells, where it outnumbers calcium by about ten thousand to one. It is therefore the ion most likely to replace any calcium that has been lost by electromagnetic exposure. An increase in the chemical activity of potassium will therefore increase its ability to replace calcium and so increase calcium loss from the membrane and further reduce its stability.

### **Calcium loss and leaky membranes underlie many biological effects.**

We have seen how the loss of calcium from cell membranes is enhanced at the 16Hz potassium resonant frequency. Also, any metabolic consequences of this calcium loss may be similarly enhanced. Any bioelectromagnetic responses that peak or trough at 16Hz is evidence that they stem from divalent ion depletion in membranes. In fact, many biological responses appear to peak at 16Hz. These include stimulations of the growth of yeast (Mehedintu and Berg 1997) and higher plants (Smith *et al.* 1993), changes in rate of locomotion in diatoms (McLeod *et al.* 1987), and the especially severe neurophysiological symptoms reported by electrosensitive people exposed to the radiation from TETRA handsets (which is pulsed at 17.6Hz). All of this supports the notion that a large number of the biological responses to weak electromagnetic radiation stem from the loss of calcium (and possibly other divalent ions) from cell membranes.

### **How calcium removal makes cell membranes leak**

Positive ions strengthen cell membranes because they help bind together the negatively charged phospholipid molecules that form a large part of their structure. Calcium ions are particularly good at this because their double positive charge enables them to bind more strongly to the surrounding negative phospholipids by mutual attraction and hold them

together like mortar holds together the bricks in a wall. However, monovalent ions are less able to do this (Steck *et al.* 1970, Lew *et al.* 1998, Ha 2001). Therefore, when electromagnetic radiation replaces calcium with monovalent ions, it weakens the membrane and makes it more likely to tear and form temporary pores, especially under the stresses and strains imposed by the moving cell contents. Normally, small pores in phospholipid membranes are self healing (Melikov *et al.* 2001) but, while they remain open, the membrane will have a greater tendency to leak. This can have serious metabolic consequences as unwanted substances diffuse into and out of cells unhindered, and materials in different parts of the cell that should be kept separate, become mixed.

### **Demodulation**

Both extremely low frequencies and radio waves that have been amplitude modulated at extremely low frequencies give biological effects, but unmodulated radio waves are relatively (but not completely) innocuous. This implies that living cells can demodulate a modulated signal to extract the biologically active ELF. Furthermore, if they are to respond to cell phone and WiFi signals, they must be able to do it at microwave frequencies, but how do they do it?

The most likely explanation lies in asymmetric electrical properties of ion channels in cell membranes imposed by the *membrane potential* between the inside and outside of the cell. They will behave like electrically biased point contact Schottky diodes in which electricity passes more easily in one direction than the other. This is all that is needed to rectify and demodulate the signal. A non-biological example of this effect is a radio set that was made from a single carbon nanotube (see <http://tinyurl.com/m4u75o> ). The asymmetry induced by applying a DC voltage between its ends allowed it to demodulate and even to amplify radio signals, including those at microwave frequencies.

The nanotube has a similar diameter to a typical ion channel in a cell membrane, so it seems likely that the ion channels in cell membranes could perform a similar function, powered by the cell's membrane potential. The low-frequency component would then appear across the membrane, where it could do most damage. In as much as our *tight junction barriers* have a similar trans-barrier potential (around 70mV for the skin barrier with the inside of body positive) the ion channels of the whole barrier could act in concert to demodulate the signal, the damaging low frequency components of which could then be applied to and affect the whole body.

### **Natural defence mechanisms**

The body is able to detect electromagnetic radiation and so minimise resulting damage. This ability probably evolved over countless millions of years to mitigate the effects of ionising radiation from cosmic rays and non-ionising radio frequencies from lightning during thunderstorms. Some of them are as follows: -

#### **Calcium expulsion**

The concentration of free calcium in the cytosols of living cells is normally kept extremely low by metabolically-driven ion pumps in the cell membrane. Under normal circumstances, the entry of free calcium ions is carefully regulated and small changes in their concentration play a vital role in controlling many aspects of metabolism. These processes can be disrupted if electromagnetically-induced membrane leakage lets extra and unscheduled amounts of calcium into the cell, either from the outside or from calcium stores inside. To compensate for this, the mechanism that normally pumps surplus calcium out can go into overdrive. However, its capacity to do this is limited because, if the pumping were too

effective, it would hide the small changes in calcium concentration that normally control metabolism.

**Gap junction closure:** - If calcium extrusion fails and there is a large rise in internal calcium, it triggers the isolation of the cell concerned by the closure of its gap junctions (tiny strands of cytoplasm that normally connect adjacent cells) (Alberts *et al.* 2002). This also limits the flow of electric currents through the tissue and so reduces the effects of radiation.

#### Ornithine decarboxylase (ODC)

The activation of the enzyme *ornithine decarboxylase* is triggered by calcium leaking into cells through damaged membranes and by nitric oxide produced by damaged mitochondria. This enzyme leads to the production of chemicals called *polyamines* that help protect DNA and the other nucleic acids needed for protein synthesis. One such polyamine is spermine, which normally protects the DNA of sperm and is also responsible for the characteristic smell of semen.

#### Heat shock proteins

These were first discovered after exposing cells to heat, but they are also produced in response to a wide variety of other stresses, including weak electromagnetic fields. They are normally produced within minutes of the onset of the stress and combine with the cell's enzymes to protect them from damage and shut down non-essential metabolism (the equivalent of running a computer in "safe mode").

When the production of heat shock proteins is triggered electromagnetically it needs 100 million million times less energy than when triggered by heat, so the effect is truly non-thermal (Blank & Goodman 2000). Their production in response to electromagnetic fields is activated by special base sequences (the nCTCTn motif) in the DNA of their genes. When exposed to electromagnetic fields, they initiate the gene's transcription to form RNA, which is the first stage in the synthesis of the protein (Lin *et al.* 2001). The job of these heat-shock proteins is to combine with vital enzymes, putting them into a sort of cocoon that protects them from damage. However, this stops them working properly and also drains the cell's energy and resources, so it isn't an ideal solution either.

#### Our defences protect us from thunderstorm radiation but not from cell towers, DECT phones and WiFi

As we can see, our natural defence mechanisms try to limit the electromagnetically-induced damage, but they cannot be deployed without using extra energy and disrupting the cell's normal functions. They originally evolved to protect us from occasional weak natural radiation, such as that from thunderstorms. However, prolonged or repeated exposure such as that from cell towers, WiFi and most DECT base stations is harmful because they normally run continuously and disrupt metabolism for long periods and is expensive in bodily resources.

These resources have to come from somewhere. Some may be drawn from our physical energy, making us feel tired, some may come from our immune systems, making us less resistant to disease and cancer. There is no hidden reserve. As it is, our bodies are constantly juggling resources to put them to best use. For example, during the day, they are directed towards physical activity but during the night, they are diverted to the repair of accumulated damage and to the immune system. Day and night irradiation from cell phone towers (which run continuously) will affect both, with little or no chance to recover. In the long term, this is likely to cause chronic fatigue, serious immune dysfunction (leading to an increased risk of disease and cancer) and many of the neurological symptoms frequently

reported by people living close to mobile phone base stations (see Abdel-Rassoul *et al.* 2007).

### **How can we make our electromagnetic environment safe?**

Firstly, there may be no need to give up our electrical appliances domestic appliances or cell phones. It is possible to make most of them much safer. All that is needed with domestic wiring is low-tech electromagnetic hygiene. As for cell phones, the operators have known for over a decade how to modify the radiated signal to make it safe; they have just chosen not to do so. I will deal with these one at a time.

#### **Domestic wiring**

It is easy to screen the electrical field from wiring by enclosing it in earthed metal conduits or using screened cable with an earthed screen. We cannot screen the magnetic field in this way but by careful design of the circuits, we can make the magnetic fields of the live and neutral wires cancel each other out. To do this, all you need is to make sure that the live and neutral wires to any device are as close together as possible (preferably twisted together) with each device having its own connection to the main distribution panel. The cheap UK practice of using ring mains (where many plug sockets are connected in a ring, beginning and ending in the distribution panel) should be made illegal. This is because differences in the resistance of the conductors mean that electricity flowing to any plug socket may not flow back the way it came so that their magnetic fields do not cancel and there will be an unnecessarily high field surrounding the whole ring.

Another source of problems is the use of unearthed double insulated appliances. Although there is very little risk of shock, they still emit strong magnetic fields and electric fields at about half the supply voltage, which some people find intolerable.

#### **Cell phones**

While we can block or cancel the electromagnetic fields associated with domestic wiring, we cannot do this with cell phones or DECT phones, which depend on radio frequency radiation transmissions if they are to work. However, we can make this radiation much less biologically active. There are at least two ways to do this. The first was devised, tested and patented by Theodore Litovitz working at the Catholic University of America in the 1990s. All you have to do is to add low frequency electromagnetic noise to the signal.

#### **The theory behind Litovitz's method.**

His idea was to add a random ELF (noise) magnetic field to the regularly repeating fields from power lines or cell phones. It works on the principle that most of the biological effects of electromagnetic fields are due to the relatively slow but progressive loss of calcium from cell membranes, which then makes them leak. However, the effect on any cell takes place only within certain amplitude windows, as I described earlier. We may not be able to prevent this leakage just by reducing the power of the field. All this might do is to put other cells (perhaps nearer the source) into their amplitude windows and we may be no better off.

However, if we add a second magnetic field with a randomly varying amplitude, cells are constantly being driven in and out of their amplitude windows and do not spend long enough in their windows to lose significant amounts of calcium before leaving their windows. The lost calcium then floods back and there is no biological effect. This theory has been tested in several biological systems and found to work.

Much of Litovitz's work used the in production of the enzyme ornithine decarboxylase (ODC) by tissue cultures as an indicator of radiation damage to living cells. The activity of this enzyme increases several fold when exposed to electromagnetic fields (Byus et al. 1987). ODC is part of a defence mechanism against the radiation and an increase in its production is taken as an indication that damage is occurring. Conversely, if the random signal prevents its production, it is an indication that damage is not occurring.

Work in Litovitz's laboratory was mainly concerned with mitigating the effects of 60Hz power line frequencies and he found that adding a random (noise) magnetic field of about the same strength completely reversed their effects on ODC production in mouse tissue cultures (Litovitz *et al.* 1994b) and also the deformities induced by 60Hz fields in chick embryos (Litovitz *et al.* 1994a)

They then went on to study the effects of modulation frequency on 845MHz microwave radiation on ODC production in mouse tissue cultures. They found that constant frequencies between 6 and 600Hz were harmful as measured by ODC production. Simple amplitude modulated speech (which is more random) did not stimulate ODC production, neither did frequency modulated microwaves and frequency modulated analogue phone signals. Continuous microwaves had only a slight effect.

#### **Most microwave pulse frequencies are harmful**

Penafiel et al. (1997) working in Litovitz's laboratory concluded that there were only serious health problems when the microwaves were modulated to give pulses of a standard height (amplitude) generated at frequencies between 6 and 600Hz. There was virtually no effect above 600Hz. This corresponds to Blackman *et al.* (1988) observation that calcium release from brain tissue did not occur above 510Hz.

It would appear that the mobile telecommunications industry had not done their homework before selecting the pulse frequencies for their digital communications, since they virtually all fall within this biologically active range; e.g. 2G GSM cell phones (217Hz), TETRA (17.6Hz), DECT phones (100Hz), WiFi (10Hz), and 3G UMTS signals with time division duplex (100Hz and 200Hz) all of which are potentially harmful. There could be other harmful effects of the radiation that do not trigger ODC production or calcium release but, at the very least, these pulse frequencies should not have been used if the cell phone industry had acted due diligence. .

However, Litovitz (1997) found that even these could be made safe by superimposing a low frequency magnetic field on the signal. They found that it prevents the production of ornithine decarboxylase (ODC) by mouse tissue cultures in response to digital cell phone signals. For example, a random field between 30 and 100Hz with an RMS strength of 5 microtesla completely inhibited the ODC production induced by a cell phone signal with an SAR of about 2.5 W/kg. A coil within the handset could easily deliver a random magnetic field of this magnitude and probably protect the user from the harmful effects of its radiation.

Also Lai (2004) showed that a 6 microtesla random noise field completely reversed the deleterious effect of 2450 MHz continuous waves with an SAR of 1.2 W/kg on rat memory. In none of the above experiments did the random noise have any effect in its own right and, on these criteria, is completely harmless.

#### **Balanced signal technology**

While Litovitz's method might protect the user from the radiation, because magnetic fields dissipate rapidly as you move away from the source, they may not protect other people

nearby, who are out of range of the protective random field. By the same token, random low frequency magnetic fields emitted by a cell phone base station would not be able to protect most users. For this you may need something like a system that I devised myself, to which I gave the name "Balanced Signal Technology". I am not claiming any patent rights and anyone who wants to test and use it can do so free of charge.

The principle is very simple and involves transmitting two complementary mirror image signals on different carrier frequencies; i.e. when one has a pulse, the other has a gap. The base station would have no problem with this since they would look like two separate phone calls. However, living cells would be unlikely to distinguish between the two carrier frequencies and the pulses on each would cancel and it would look like a relatively harmless continuous wave. It would need very little extra bandwidth since only one of the signals need be used, with the other one being effectively thrown away and they could all be dumped on the same frequency. In theory, this technology could be applied to both handsets and base stations, but has not yet been tested.

The cell phone companies should know about both methods to make cell phones safer but there is no evidence that they are interested, possibly because to implement them would cost money with no extra benefit to themselves. It looks very much as if they would prefer many people to become sick and perhaps die, rather than admit that their safety rules are based on false premises and that their current technologies are not yet safe.

#### **What can we do about it ourselves?**

Very few people would want to give up their cell phones, but if you have one, for your own personal safety, keep your calls on it short and infrequent so that your body has a chance to recover in between times. Use text (which takes seconds to transmit) rather than voice calls and avoid unnecessary Internet downloads. The choice is yours, but spare a thought for the people living near the base stations. Some may be badly affected by their continuous radiation but they have no choice. Your cell phone calls will contribute to their problems, so your restraint may help them too.

Also, don't forget your own personal sources of continuous radiation such as WiFi routers and DECT phone base stations, which can be even more harmful since they are closer. Avoid using WiFi altogether. Ethernet connections via cable are not only safer, but faster, more reliable and offer greater security. Various "Homeplug" devices that connect an the Ethernet socket of your computer to the router via the household electricity supply are second best alternatives. They are not perfect since there is still some radiation from the wiring; especially with those offering faster speeds.

DECT phones should also be avoided if at all possible. But, if you must have one, a reasonable compromise is to use only one that switches off its base station automatically between calls. At the time of writing, the only DECT phones that do this are the Eco Plus models manufactured by Siemens; e.g. the Siemens Gigaset C595. However, make sure they are programmed to work in the Eco Plus mode since this is not the default setting.

#### **Screening and its limitations**

Many electromagnetically intolerant people will want to screen themselves from the fields but we need to understand a little about them to get the best results.

#### **The near-field**

An alternating electromagnetic field consists of an electrical field and a magnetic field. The electrical field is produced by a voltage gradient and is measured in volts per metre. The magnetic field is generated by a flow of current and is measured in tesla. When you are close to the source (typically within one wavelength) you are in the *near-field*, where the electrical and magnetic fields are mainly separate.

At power line frequencies, the wavelengths run into thousands of miles, so you are bound to be in the near field for power lines. For example, standing under an alternating power line would expose you to a voltage gradient due to the difference between the voltage of the line (set by the power company) and the Earth. You would also be exposed to a *magnetic* field proportional to the current actually flowing through the line, which depends on consumer demand. Both the magnetic and the electrical fields can induce electric currents in your body and are potentially harmful, but the magnetic field is worse because it penetrates living tissues more easily, goes through most walls and aluminium foil as if they were not there, and is very difficult to screen.

### The far field

However, as you move away from the source, the two fields feed on each other's energy and combine to give photons of radio waves. This is usually complete within a few wavelengths, after which you are in the so called *far-field* where all the power takes the form of radio waves. Your exposure to these is usually measured in units of power (e.g. microwatts per square metre) or its associated voltage gradient (e.g. volts per metre).

The importance of this as far as we are concerned is that radio waves, are like light waves and are relatively easy to absorb and reflect. This can be done, using earthed metal foil or other electrically conductive materials such as carbon-based paints and metallised textiles. For practical purposes, this means that you can screen yourself against the radiation from a cell tower, WiFi router, or DECT phone base station if they are several wavelengths away (several tens of centimetres) but not from a cell phone held against your head, where you are in the near field and the raw magnetic component will penetrate deep into your brain.

To give an idea of the hazard, magnetic fields lower than one microtesla (a millionth of a tesla) can produce biological effects, but using a 2G (GSM) cell phone or a PDA exposes you to low frequency magnetic pulses that peak at several tens of microtesla (Jokela *et al.* 2004; Sage *et al.* 2007). These come mainly from the battery circuits and are well over the minimum needed to give harmful effects. When they are added to the damaging effects of their microwave fields themselves, these devices are potentially the most dangerous sources of electromagnetic fields and radiation that the average person possesses.

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